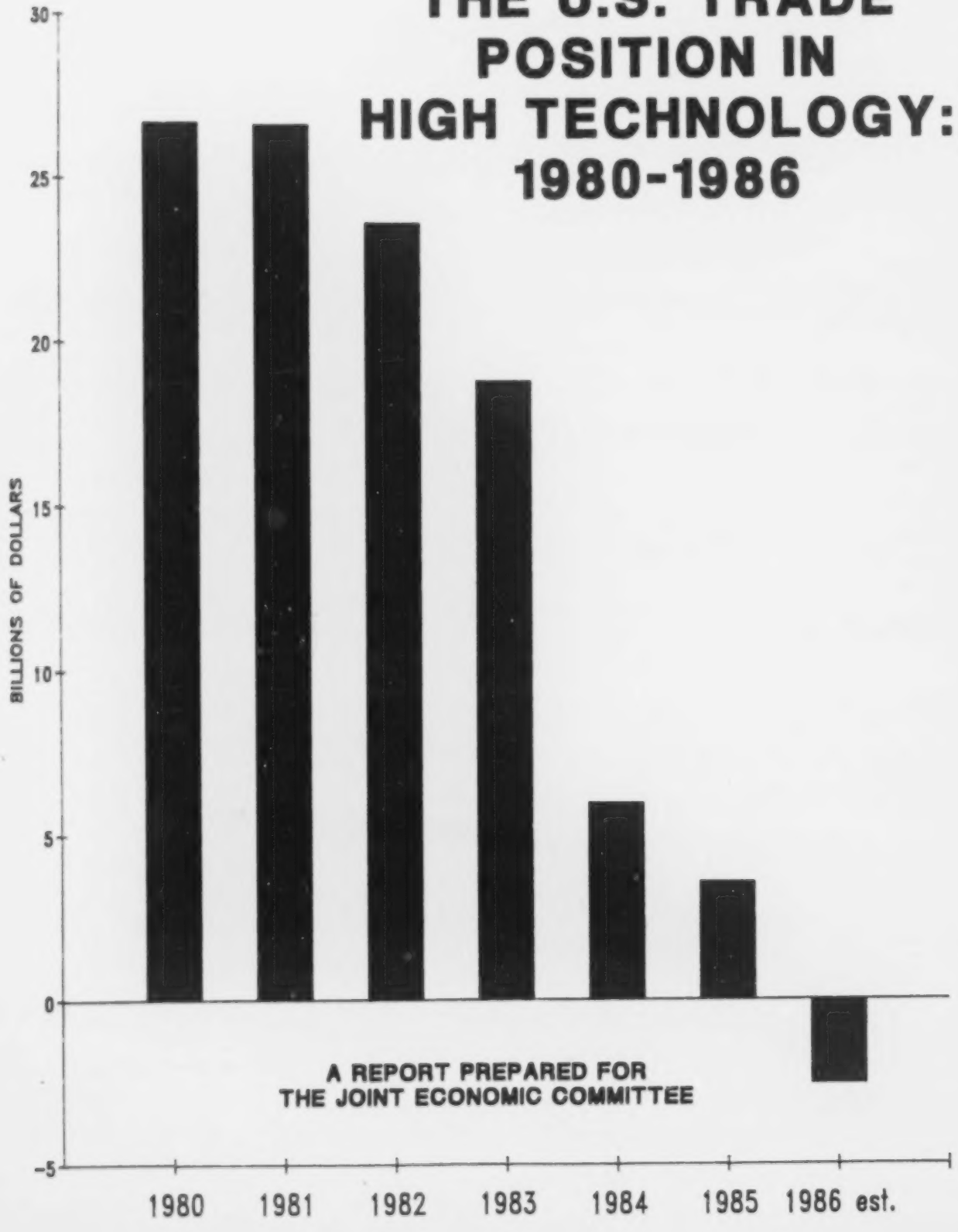
THE U.S. TRADE POSITION IN HIGH TECHNOLOGY: 1980-1986



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The U.S. Trade Position in High Technology: 1980-1986

A Report Prepared for
The Joint Economic Committee
of the
United States Congress

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Introduction and Summary

It is widely understood that there has been a dramatic decline in the United States' international trade position over the past few years. While this process has been disruptive for large segments of our economy, there are many who argue that the trade deficit is a transitory and self-correcting phenomenon. In this view, the trade deficit is part of a natural process of restructuring the American and international economies: Old "smokestack" industries in the U.S. naturally lose their competitive edge to producers in countries with lower labor costs and better access to raw materials, with the U.S. industrial base shifting to high-technology industries where it is argued that we have a natural comparative advantage due to our large research base and the opportunity for continued world leadership.

Judged by recent trade trends, however, the U.S. has not been maintaining, much less increasing, its position in high-technology trade. In fact, the substantial trade surpluses we once enjoyed in this sector appear to be sliding toward deficit. This paper explores recent trends in American "high-technology" trade using data on a group of industries the Commerce Department defines as "high

tech" on the basis of their heavy reliance on research and development expenditures.[1] These industries (including, among others, computers, scientific instruments, aircraft and specialty chemicals, but excluding low-research intensive consumer electronics categories like TVs, stereos and VCRs) have maintained a strong international trade position, until recent years.

In 1980, the high-technology industries produced a trade surplus of $27 billion, but this surplus has declined in every year since. In 1985, the high-tech surplus shrunk to $4 billion, and the trends established in the first two quarters of this year make it likely that 1986 will produce the first full-year high-tech trade deficit since this category was first identified.

Explaining this dramatic erosion in the important high-tech sector requires analysis of a number of different factors. Certainly macroeconomic factors contributed to

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[1]The definition of high technology used for this paper is designated "DOC3" by the U.S. Department of Commerce. This definition measures R&D content based not only on R&D intensity of direct shipments but also the R&D intensity of intermediate goods producers. Included in the definition are computers, aircraft and parts, instruments, and communications equipment. See U.S. Department of Commerce, "U.S. High Technology Trade and Competitiveness," February 1985, pp. 37-39.

the decline of America's high-tech trade position. The overvalued dollar has made it more difficult for American high-tech firms to compete abroad--especially in the European market--and helped facilitate foreign sales in this country. In addition, the very rapid rise in U.S. domestic demand following the 1981-82 recession helped to pull high-tech imports into the U.S. market.

But differences in macroeconomic performance and currency alignments do not provide a complete explanation for either the speed or the extent of the deterioration of the high-tech trade balance. Other factors appear to be at work. The paper discusses three factors that influence U.S. high-tech exports: foreign trade practices, export controls, and offset agreements.

High technology is perceived as an important growth sector in many nations, and a number of our competitors have acted to protect and promote their own domestic production at the expense of U.S. exports. U.S. high-tech producers have also been put at a competitive disadvantage by the way in which this country administers its system of national security export controls, and by the practice of

using "offset agreements" as part of the process of selling American military hardware abroad.

Even these factors and macroeconomic differences combined still do not fully explain the especially precipitous decline in our high-tech trade position with both Japan and the Southeast Asian Newly Industrializing Countries (NICs).

In the case of the Southeast Asian NICs, it appears that much of the deterioration in the U.S. high-tech trade balance is accounted for by American firms making greater use of their subsidiaries or independent contractors located in these countries where labor costs remain low by American standards. Through such arrangements, American-owned corporations remain competitive, while America as a place of production does not.

In the case of trade with Japan, the overvalued dollar and the difference in domestic growth rates appear to explain only part of the huge deterioration of the U.S. bilateral high-tech trade balance with Japan. The degree of deterioration, which is especially marked in the area of electronics goods, suggests that U.S. firms may have lost

their comparative technological strength relative to their Japanese competitors. Such a loss would not be reversed by a decline of the dollar relative to the yen.

Although the paper offers no specific prescriptions for reversing the overall decline in our high-tech trade position, it is clear that recent trends must be reversed if the United States is to achieve strong growth and maintain a leading position in the world economy in the years ahead.

I. Review of the U.S. Trade Position in High Technology

In the first two decades of the post-World War II era, inflation throughout the international economy was fairly low, with little variability across countries. Dollar exchange rates were relatively stable, and the U.S. had a strong surplus in its trade accounts. Those conditions began to change in the 1970s. In 1971, the U.S. merchandise trade balance shifted into deficit for the first time and, except for 1973 and 1975, has remained negative ever since.[2]

Despite the deterioration of the merchandise trade balance, the manufactures component of U.S. merchandise trade remained in the black through the early 1980s (except for 1978).[3] In 1980, U.S. manufactures exports still exceeded imports by $14 billion; but in 1981, the surplus shrank to $6 billion. Then the roof fell in. The perennial surplus turned to a deficit of $13 billion in 1982--followed by ever-growing deficits of $41 billion in

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[2]See Appendix A for a list of all data sources.

[3]The manufactures component covers chemicals, machinery and transport equipment, basic manufactures, and other manufactures (except mineral fuel products, processed food, fats and oils, and some military weapons).

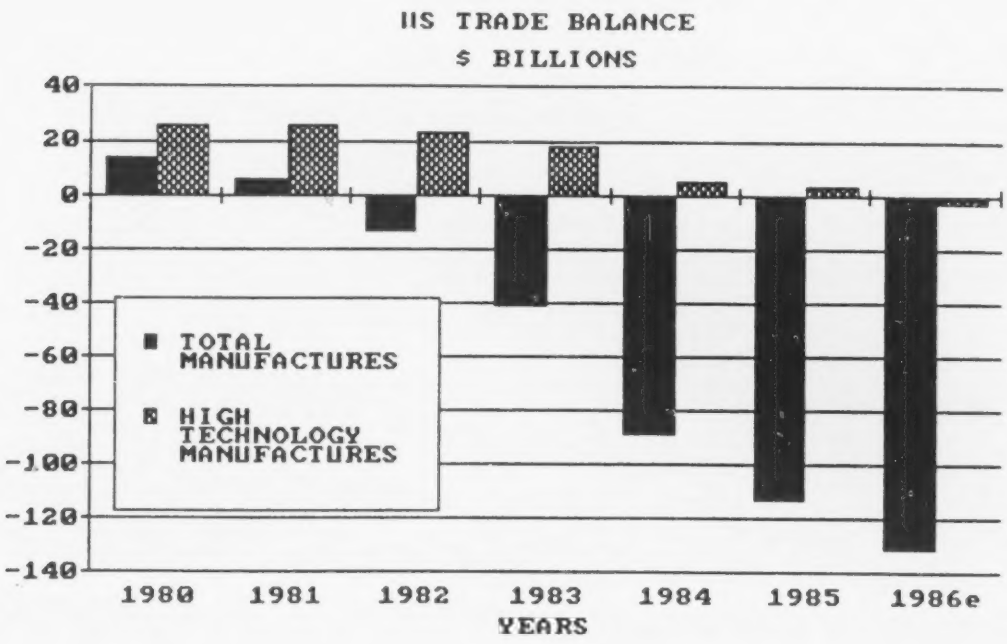
1983, $88 billion in 1984, $113 billion in 1985, and an estimated $138 billion in 1986. (See Figure 1-A in text below and Figure 1 at end of report.)

The high-technology sectors comprise about 30 percent of total U.S. manufactures trade. This collection of research-intensive industries historically has been in consistent surplus position. In fact, prior to the 1980s, the surpluses generated in this sector far exceeded deficits recorded in the less technology-intensive sectors of U.S. manufactures tradeables. In 1980, for example, the high-tech sector had a surplus of $27 billion, whereas, the nonhigh-tech manufactures sector ran a deficit of $13 billion. From 1982 onward, however, the U.S. strength in high tech was unable to keep the overall manufactures balance out of deficit.

The high-tech sector continued to record trade surpluses--albeit of declining magnitude--while the position of other manufactures plummeted. By 1985, for example, the U.S. surplus for high-tech manufactures was down to $4 billion, while the remainder of manufactures recorded a deficit of $117 billion. In 1986, even high-tech manufactures could record its first full-year trade

deficit. For the first half of the year, the U.S. exported $35.2 billion in high-tech goods, while high-tech imports totaled $36.5 billion--resulting in a first-half 1986 deficit of $1.3 billion.[4]

Figure 1-A



Source: U.S. Department of Commerce

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[4]It should be noted that according to the data made available by the Commerce Department, the U.S. has posted high-tech trade deficits in the past for single quarters. In those cases, exports were sufficiently strong in the surrounding quarters to maintain a high-tech surplus for the year.

A more detailed review of the U.S. trade performance over the last six years reveals how the high-tech performance compared to overall U.S. trade patterns. Looking first at the merchandise trade performance, 1980 to 1986, U.S. exports to the world stayed practically flat, while total imports rose over 40 percent.[5] (See Figure 2.) Large increases in imports over the period were recorded from Japan and the Newly Industrialized Countries (NICs) of Southeast Asia[6] (119 and 123 percent respectively), with most of the increase coming since 1983.

Trends for U.S. manufactures trade are very similar to those for merchandise. This is not surprising, since almost 75 percent of our merchandise trade in 1986 will be manufactured goods. Overall, manufactures exports have changed very little, though there is a wide degree of variation in performance by export destination. (See Figure 3.) The deterioration of U.S. competitiveness in manufactures is most evident on the import side--with 1986 imports likely to be more than double the 1980

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[5]The figures in this section base all trade in 1980 to 1.0 and show the indexed time series for 1980-86. (Using 1986 first-half data to estimate full 1986 results.)

[6]In this paper, the term NICs is used to refer collectively to Korea, Taiwan, Hong Kong, and Singapore.

levels. This surge in manufactures imports occurs for all regions of import origination. (See Figure 4.)

U.S. manufactures exports grew slightly faster--2 percent--than total U.S. merchandise exports between 1980 and 1986. U.S. manufactures exports to Japan outperformed manufactures exports to all other destinations relative to merchandise exports.[7] Electronics exports led this trend.

Manufactures imports grew much faster than total merchandise imports--to a projected 49 percent above the level of merchandise imports by 1986. Clearly, manufactures imports were the primary reason for the overall growth in merchandise imports. (See Figure 5.) The biggest change on the import side was in trade with the so-called Rest-of-World (ROW) category of countries.[8] Absent the strong increase in manufactures imports from this region, the manufactures trade import performance tracked very closely the merchandise pattern.

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[7]On the import side, U.S. merchandise imports from Japan, for all practical purposes, are the same as manufactures.

[8]Rest-of-World (ROW) includes the Caribbean-Basin countries, Latin America, the Middle East, Africa, and Asian countries other than the four Southeast Asian NICs and Japan.

We believe that much of the growth in imports from the ROW countries is most likely due to U.S. firms outsourcing production, that is, contracting for production or assembly of U.S. sourced subassemblies.[9] These firms sought to maintain their cost competitiveness by locating production offshore in the low-labor-cost regions of the world. As will be explained later, the growth in imports from this region is not due directly to changes in the dollar exchange rate with the currencies of these countries. It is more likely to have reflected the response of U.S. firms to the high dollar valuation relative to the major European currencies and the yen.

Against these overall trends, how did the high-tech segment of manufactures trade fare over the 1980-86 period? First, looking just at changes in the absolute level of trade, high-technology exports were up slightly over this period--29 percent. (See Figure 6.) High-tech exports to

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[9]This is based on reviewing other sources of data on trade with the Southeast Asian NICs, including so-called 806-807 data which identifies U.S. content of trade. It is also supported by interviews with executives of U.S. firms, especially in the electronics industry.

Japan, starting from a fairly small base, increased by over 60 percent, with most of the growth occurring since 1982.[10]

Imports of high-technology goods grew phenomenally--increasing to more than 2.5 times 1980 levels. Imports of high-tech products from Japan rose three-fold. (See Figure 7.) Compared to overall manufactures trade, high-tech trade performed slightly better on the export side. (See Figure 8.) This relatively better performance would be expected if the U.S. had a comparative advantage related to technology rather than price competitiveness.

On the import side, however, the performance of the high-tech sector relative to total manufactures did not clearly manifest any special U.S. competitive advantage due to technology. Overall, high-tech imports grew somewhat faster than overall manufactures imports. The largest increase was for high-tech imports from Japan, which grew 1.5 times more than overall Japanese manufactures shipments to the U.S.

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[10]As a point of reference, the U.S. 1983 share of industrial country high-technology exports was 30 percent of the total (U.S. Department of Commerce, United States Trade Performance in 1984 and Outlook).

The trade patterns for the high-tech sector were generally reflected in the patterns for electronics, the largest subsector of high tech.[11] In 1985, the electronics sectors represented about half of total U.S. trade of high-tech goods. Growth in the electronics sector led high-tech exports, with overall electronics exports in 1986 up 20 percent relative to total high-tech exports. (See Figure 9.) This growth was influenced by increased U.S. exports to the Southeast Asian NICs--up 30 percent relative to high-tech exports to the same region. Again, the likely explanation for this rapid growth in exports is that it probably reflects the efforts of U.S. firms to outsource production to low-labor-cost regions. It is believed that U.S. firms sought to take advantage not only of the lower labor costs for assembly, but also increasingly the lower overhead costs for technical and engineering support. This is a new factor influencing U.S. firms to locate facilities offshore.[12]

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[11]The electronics sector includes communications equipment, computer and business equipment, scientific and analytic instruments and electronic components but excludes consumer electronics.

[12]Some anecdotal reports indicate that foreign firms are even undertaking R&D activities for new product development for U.S. firms. (See, for example, Electronic Business, October 1, 1986, p. 30.)

Imports of electronics products from the Southeast Asian NICs also showed a marked growth--up nearly five-fold--the expected result from the decision to reexport semi- or fully-finished products back to the U.S. market. Over this period, U.S. exports of electronic products to Japan--the largest national market for electronics in the world--grew at about the same rate as total high-tech exports. What is not evident in the trend in electronics exports to Japan is that the absolute value of U.S. exports is still quite small, only about one-quarter of the value of U.S. electronics imports from Japan.

In summary, our traditional trade surplus in high-technology goods has declined over the past six years at a rate only slightly slower than the deterioration of our overall manufactures trade account. But this gradual decline overall conceals much more dramatic declines in bilateral high-technology trade with both Japan and the NICs. While our overall high-tech balance declined 97 percent from 1980 to 1986, the balance with Japan slid 489 percent and declined 2900 percent with the Southeast Asian NICs.

These findings suggest there are both general factors that explain the gradual decline in our high-tech trade position across a large number of countries, and specific factors that explain the much sharper declines in our competitive position vis-a-vis Japan and the NICs. The remainder of this paper will be devoted to an analysis of these general and specific explanations for our deteriorating high-tech trade position.

II. Some of the U.S. Factors That Explain the Change in the U.S. Competitive Position in High-Technology Trade

At the top of most lists of factors that have influenced U.S high-tech trade over the past six years are the effects of U.S. macroeconomic policy. Macroeconomic policy influenced U.S. trade through two broad channels: first, through changing U.S. price levels and exchange rates; and, second, through an increasing disparity in rates of demand growth between the U.S. and our major trading partners. These macro factors unquestionably caused a squeeze on the U.S. high-technology trade balance. There were also a number of other factors that influenced U.S. competitiveness in high technology, to varying degrees. The ones addressed here are exclusively related to trade. These include offshore sourcing or outsourcing, U.S. export controls, and certain forms of trade-distorting practices, including offsets (a type of compensation in military transactions).

A. Macroeconomic Conditions in the 1980-86 Time Frame and Their Influence on U.S. High-Tech Trade

Changes in U.S. macro policy affected trade with different areas of the world in different ways. Thus, it

is helpful to consider separately U.S. trade with other major developed economies as distinct from trade with the NICs and other relatively low-labor-cost areas.

U.S. high-tech exports to developed countries are usually for consumption in those countries. Therefore, changes in relative economic conditions between the U.S. and Canada, Japan, and the European Community influence the bilateral competitiveness of the U.S. firms. On the other hand, a significant portion of U.S. high-tech exports, especially in electronics, that goes to the NICs and other low-labor-cost areas (especially Mexico, for example) is for further assembly and reexport, not for final sale into the local economy.[13] In these markets, relative costs, as they are affected by exchange rate movements, have a larger impact on trade flows than relative rates of domestic demand.

The difference between absorption in developed countries versus transshipment of product through the NICs means that U.S. macro policies have a split-level effect on

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[13]This conclusion is based on discussions with electronics industry executives and reviewing Tariff Item 806/807 data, which identifies the U.S. content of imports for certain categories of trade.

high-tech trade. This split-level effect on U.S. high-tech trade competitiveness relative to the major developed countries and with respect to the remainder of the world shows up in the trends in the trade data described next.

A.1 Effects of the Strong Dollar on U.S. High-Tech Trade Have Been Overstated

According to the standard Federal Reserve Board computation for the value of the dollar relative to the currencies of our major trading partners, the dollar rose more than 70 percent from 1980 to its peak in mid-1985. This strengthening of the dollar caused a significant squeeze on U.S. high-tech tradeables. But the degree may not have been as large as these numbers suggest for two reasons. First, the much-cited Federal Reserve composite measure for overall trade-weighted exchange rates overstates the extent of exchange-rate movements for the high-tech sector over the 1980-85 period. Second, a different picture of exchange-rate changes emerges if the exchange-rate movements for the major developed economies (Canada, Japan, and the EC) are examined separately from

exchange-rate changes relative to the currencies of the NICs and Mexico.[14]

Our analysis is based in part on comparing changes in the Federal Reserve Board composite trade-weighted exchange rate series (we will call it the "Fed" exchange rate) and an exchange-rate series developed using U.S. electronics trade weights for each of the relevant bilateral exchange rates (the "electronics" exchange rate). This second series reflects the geographic distribution of trade for the largest subsector of high-technology products.[15]

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[14]A trade-weighted exchange rate is a composite of the value of more than one country's currency relative to the U.S. dollar. The dollar values of foreign currencies are aggregated by giving each a weight based on some measure of the country's trade. In the case of the Federal Reserve composite, the composite series consists of the aggregate of dollar value of the currencies of West Germany, Japan, France, the United Kingdom, Canada, Italy, the Netherlands, Belgium, Sweden, and Switzerland. The weights used in forming the Federal Reserve composite are the share of world trade represented by each country's total trade. The electronics trade-weighted exchange rate constructed for this report uses the share of total electronics trade between each country and the U.S. as the weights. The countries used in the nominal electronics series are Japan, Canada, the European Community (based on the dollar value of the European Currency Unit), Mexico, Singapore, South Korea, and Malaysia. The real electronics series excludes Singapore due to incomplete data.

[15]The electronics exchange rate series was constructed by using the total bilateral electronics trade to weight the bilateral exchange rates, transformed by taking the natural log, and then aggregating. It is indexed to make 1980 equal 100.

The Fed exchange rate for the U.S., whether measured by nominal exchange rates or nominal exchange rates adjusted for relative inflation (the real effective exchange rate), shows the dollar rising against foreign currencies by about 70 to 80 percent between 1980 and 1985. (See Figure 10.) In contrast, the electronics exchange-rate series did not increase over the 1980-85 period as much as the Fed series. Using nominal exchange rates, for example, the electronics series peaked at 152 in 1985.2--one-quarter later than the peak for the Fed series, and about 30 points lower. (See Figure 11.) If real effective exchange rates are compared, a similar story emerges--with the real effective series for electronics trade peaking well below the Fed series. (See Figure 12.) Thus, electronics trade was less affected by currency misalignments than is commonly believed.

Comparisons of the nominal and real electronics series suggests there were essentially two distinct periods of adjustment. (See Figure 13.) From 1980 to mid-1982, both series increased by 20 to 25 percent over the 1980 level. After mid-1982, the nominal series continues to increase, while the real effective exchange-rate series balloons briefly from 1984.3 to 1985.3 before returning at the end

of 1985 to the early-1982 level. Thus, despite the unwinding of exchange rates in late 1985 into 1986, real effective exchange rates for electronics trade remained, on average, 25 percent above their 1980 level for over four years. Exchange-rate misalignments have therefore contributed to the deterioration of electronics trade, although that contribution is generally smaller than believed. But the currency misalignment as it affects electronics also has been more persistent, with the electronics-weighted exchange rate declining more slowly in recent months than the Fed measure of the value of the dollar.

A.1.1 Regional Disaggregation of Exchange Rate Effects

Further disaggregation by region is required to explain more completely how U.S. high-tech trade behavior was influenced by exchange rates. Looking first at the changes in the aggregate real effective exchange rate for the major trading areas, it is clear the movements in the Fed composite series were heavily influenced by the strength of the dollar against the European currencies,

especially in the 1984-85 time frame.[16] (See Figure 14.)[17] The major European currencies, measured by the European Currency Unit (the ECU), appreciated 77 percent by the fourth quarter of 1984. Because the Fed series gives the European currencies such a heavy emphasis, the overall movement of the composite closely followed the movement of the European currencies. On the other hand, it can be seen in Figure 14 that the upward trend in the Fed series between 1982 and 1984 was not driven by the real yen/dollar series which rose to a peak in late 1982 and then declined somewhat until early 1985. The yen rose again in 1985, but the peak-1982 to peak-1985 change was only 6 percent. The real yen/dollar exchange rate today is slightly below its 1980 level due to the sharp devaluation of the dollar relative to the yen.

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[16]This problem arises because the Fed series uses the global trade for the 11 countries in the series from the 1972-76 period when Europe represented a larger fraction of total trade. For example, in 1975, the European Community represented 52 percent of developed-country exports; by 1984, this had declined to under 48 percent. Japan's weight in the electronics-trade series is 39 percent or almost 3 times the weight in the Fed series.

[17]The strong relationship between the Fed composite and the movement of the European currencies--in contrast to the changes in the other exchange-rate series--is even more evident in the nominal exchange-rate series. (See Figure 16.)

Given these changes in individual real exchange rates for developed countries, recall how the high-tech trade to these countries changed over the 1980-86 period. Imports from the EC in 1986 were up 80 percent from the 1980 levels, with most of the gain coming in 1984 and 1985. This pattern is in line with the macroeconomic conditions present during this period. With respect to Japan, however, currency misalignments seem to have been less significant in determining trade flows. Japanese high-tech imports grew by nearly three-fold over the 1980-86 period--a growth pattern that appears out of line with the limited range of movement in the real exchange value of the dollar compared to the yen in that time frame. The surge of more than 266 percent in Japanese high-tech exports to the U.S. must have an explanation other than macroeconomic or currency misalignments. Although it is beyond the scope of this paper, the huge improvement in Japanese high-technology trade performance suggests to us a possibility of fundamental erosion in the U.S. technological and competitive advantage vis-a-vis Japan. If true, this would suggest that a simple realignment of currency values cannot be relied upon to fully remedy the pattern of deteriorating high-tech trade described here.

A.1.2 Influence of Exchange Rates on U.S. Trade with the NICs

Next, we turn the focus to the exchange-rate situation relative to the NICs. The real electronics trade-weighted exchange rates for the NICs tracked reasonably closely to that of the developed countries until mid-1984. Then there occurred a major strengthening of the dollar against the composite of NIC currencies.[18] (See Figure 16.) Meanwhile, the composite exchange rate series for the developed-country currencies peaks in late 1984 and then declines 10 percent. (Note that when calculated using electronics trade weights, neither the composite of NIC currencies nor the developed-country series closely follow the Fed series.) This major divergence between the electronics trade-weighted exchange-rate series for the NICs and the developed countries suggests that outsourcing to the NICs would have become an even more attractive option to U.S. electronics firms during this period. With a swing of 30 percent or more in real rates of exchange between some NIC currencies and the yen by early 1986,

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[18]Excluded from the series is the Mexican Peso. Inclusion would simply amplify the movement towards a stronger dollar in the 1984-86 period. The real NIC exchange-rate composite includes Korea and Malaysia.

there was an additional stimulus to shift production to low-labor-cost areas to offset Japanese cost advantages.

A.2 Strong Relative Growth of the U.S. Economy Influenced Trade with the Major Developed Economies

The United States economy accelerated out of the trough of the 81-82 recession with real final demand increasing by 5 percent from 1982 to 1983 and another 8.5 percent from 1983 to 1984. The Japanese expansion in this same period was significant--but not as strong as in the U.S.--with final demand rising 1.8 percent in 1983 over 1982 and 3.8 percent in 1984 over 1983. The recovery in Europe was far less robust, with demand increasing only 1 percent and then 1.6 percent between the end of 1982 and mid-1985. The uneven pattern of the recoveries is shown in Table 1.

Table 1

Real Total Domestic Final Demand

Percentage changes from previous period,
seasonally adjusted at annual rates

	1983	1984	1985
U.S.	5.0	8.5	2.8
Canada	3.4	3.5	5.4
Japan	1.8	3.8	3.7
EEC	1.0	1.6	2.0

Source: Organization for Economic Cooperation and Development, OECD Economic Outlook, Table 12, May 1986.

The faster growth in the United States between 1982-84 led automatically to a deterioration in the U.S. trade position. As U.S. demand grew faster than the demand growth in the major foreign economies, U.S. imports increased relative to exports and put downward pressure on the trade balance. The U.S. traditionally has exhibited a weakening trade balance coming out of recession, but what made this time especially bad was the very weak real growth in the other major economies. And, because U.S. high-tech firms have a far larger position in Europe than in Japan,[19] the continuing weak recovery of the European economies

[19]For example, total sales of manufactures goods by U.S. firms and affiliates in Europe were almost 25 times the total for Japan in 1982. (See Table III.D.4., U.S. Direct Investment Abroad: 1982 Benchmark Survey Data, U.S. Department of Commerce, December 1985.)

meant that U.S. high-tech exports continued to experience slower growth through 1985.

The growth of demand in the U.S. economy did not influence trade with NICs in the same way for several reasons. First, the NIC economies are still too small for relative swings in their rate of growth of domestic demand to influence U.S. bilateral trade patterns. Further, these economies were also growing faster through the 1982-85 period relative to the U.S. Thus, shifts in their patterns of trade with the U.S. were not influenced by the relative strength of the U.S. recovery in the same way as was U.S. trade with the developed countries.

B. Other Factors Influencing U.S. Competitiveness in High Technology

We next turn to several issues which add to the explanation of the trade trends in high technology. First, we describe how the decisions of U.S. firms to source components from Southeast Asia has influenced the growth in the U.S. trade deficit. By outsourcing components, many U.S. firms have sustained their competitive position in the U.S. market even though the U.S. as a place of production has lost competitiveness. Then we cover several additional

factors that, on the margin, may have negatively influenced the competitive strength of U.S. high-tech exports:[20] U.S. export controls, the proliferation of trade-distorting practices that encumber U.S. high-tech exporters, including the use of offsets by military prime contractors to increase final systems sales abroad.

B.1 Offshore Sourcing

One explanation that has been cited as a possible reason for the relative deterioration in the U.S. trade position overall, but particularly in high-tech-related trade, is the redeployment of productive assets abroad by U.S. firms. This kind of trend is theoretically consistent with the fact that the strong U.S. dollar over the 1980-85 period should have made the investment in foreign

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[20]There is evidence the U.S. research base has lost some of its relative qualitative edge to other nations. This consideration is not addressed directly in this paper, although many of the phenomena discussed herein could contribute to, or could be symptoms of, such a development. While this erosion could influence the long-term competitiveness of the U.S. on high-tech industries, it is not likely that conditions changed sufficiently abruptly just within the past five years to have contributed to the rapid changes in trade patterns described in this paper. Rather, it is more likely that there has been a long-term secular erosion of our broad technological lead that has helped foreign-based firms become increasingly competitive in technology-intensive industries.

manufacturing facilities comparatively attractive. Assuming this redeployment has, in fact, occurred, it would suggest a greater degree of permanence to the structural effects of the strong dollar on U.S. trade performance.

In order to evaluate the proposition, we constructed two rough measures of the relative proportion of U.S. manufacturing investment abroad.[21] The first measure was the change in the proportion of net fixed assets abroad between 1980-85, as reported in financial reports of a sample of Fortune 500 high-technology companies. For some companies, the proportion abroad increased. For others, that proportion declined. But there was no net trend in the aggregate.

This first measure could be influenced by exchange rates, and the data did not allow construction of a neutral series. Thus, a second measure that appeared in the company financial reports was developed--the proportion of the total square footage of corporate facilities that was located offshore. It showed the same overall patterns as the fixed asset proportions. Therefore, neither measure substantiated a relative movement offshore--in fact, both

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[21]See Appendix A for data sources.

suggested that essentially there had been no change, at least in terms of locational choices between the U.S. and the rest of the world in aggregate. Of course, this does not rule out shifts in the locus of investment within the foreign component.

Determining exactly why U.S. firms did not appear to redeploy relatively more assets offshore, given the strong dollar, is outside the scope of this paper, but we can speculate about several possible explanations. First, while the U.S. dollar was strong against the major European currencies, U.S. firms already had made major investments in Europe. And the European economic environment was not a robust one for making a large relative expansion in net new investments over much of this period.

With respect to Japan, the dollar's strength relative to the yen may have been offset by the continued difficulty of acquiring nonfinancial assets in Japan and in the high front-end costs of setting up a manufacturing facility.[22] U.S. firms making investments in manufacturing facilities in Japan are typically doing so for long-term strategic

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[22]Based on private discussions with a number of U.S. executives with facilities in Japan and/or knowledgeable about investment conditions in Japan.

reasons related to penetration of the Japanese market. What may have been viewed as a temporary misalignment of the two currencies would not have been sufficient to trigger major new investments by U.S. firms.

While there may not have been a major redeployment of direct investment offshore, U.S. electronics firms seem to have increased their use of foreign contract assembly and sourcing for components and subassemblies--so-called "outsourcing." This movement to offshore sourcing has developed especially rapidly with respect to Hong Kong, Taiwan, Korea, and Singapore--what we designate collectively here as the NICs. U.S. firms are sourcing subassemblies from low-labor-cost countries where usually the exchange rate has moved favorably--that is, where the dollar has remained relatively strong. As a result of U.S. firms' sourcing decisions, the trade balance with the NICs has deteriorated significantly. The trade data below indicates a significant surge of electronics exports and imports from this area of the world relative to overall U.S. trade performance.

Table 2

First Half Trade (Deficits) In Electronics-Related Goods
($ Million)

	1984	1985	1986
Hong Kong	(262)	(90)	(251)
Korea	(203)	(145)	(448)
Singapore	(505)	(392)	(543)
Taiwan	(486)	(580)	(740)
Total	(1456)	(1207)	(2032)

Source: U.S. Department of Commerce

For the last two decades, this region has been a primary area for the assembly of electronic components and consumer electronics goods by U.S. firms. These low-labor-cost assembly activities were followed by development of an extensive infrastructure to support high-tech manufacturing--which, in turn, permitted a more sophisticated set of contract assembly and subassembly manufacturing activities to develop.

The IBM PC became the personal computer industry standard by 1984. But by 1986, it was outsold by machines compatible with the IBM unit (so-called "clones"). The U.S. firms that produce many of these clones source most of their components and subassemblies from Taiwan, Singapore, South Korea, and Mexico. They take advantage of the low

labor cost for subassembly and the availability of low-cost components in these countries.

By reducing their basic component and subassembly costs, U.S. firms are able to compete on a cost basis directly with foreign producers of IBM compatibles. Thus, the Southeast Asian NICs (and Mexico) have seen their exports to the U.S. of electronics-related assemblies increase significantly in 1986. The table above shows the total U.S. trade deficit for electronics with the Southeast Asian NICs in just the first half of 1986 exceeded $2 billion. Growth in the U.S. market for PCs accounted for a significant portion of the overall deterioration in electronics-related trade with these four countries. For example, Taiwan alone is expected to export about $500 million in PC subassemblies and finished units to the U.S. in 1986, an increase of 50 percent over 1985 levels.

By sourcing offshore, the U.S.-based firms that distribute the completed PC units have maintained their competitive position against foreign competition, especially the Japanese, at the overall finished product level. There is an interesting distribution of economic returns from this alignment. Of the total retail value of

an IBM-compatible machine, U.S. firms capture approximately half (including final assembly costs, which represent about 3 percent of retail value.)[23] But these firms are performing virtually no manufacturing activity below the major subassemblies level. Foreign firms provide most, if not all, the major subassemblies and many of the major items such as monitors and disk drives. Ironically, assembly of the overall PC, an activity once usually relegated to an offshore low-labor-cost site, is now predominately performed in the U.S. since this represents such a small proportion of the total cost of the completed unit.

Because the use of offshore assemblies has lowered the production cost of the PC, competition among PC producers has driven down the average price paid for an IBM-compatible PC by one-third from mid-1985 to mid-1986. Further declines are expected. Thus, while U.S. consumers have benefitted from the rapid decline in prices, and while U.S. firms control the overall PC market and capture their returns from coordinating manufacturing, assembling, and distributing the product, the evidence is clear that the

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[23]Derived from information in Electronic Business, "PCs: Turning Back the Far East Tide," August 15, 1986, pp. 48-59.

U.S. is not competitive as a place of production for many of the major components and assemblies. This leaves us with a major unanswered question regarding the future of U.S. interests: Will the U.S. firms be able to keep control of the distribution channels and the systems level technology if they do not control the basic component-level technology and engage in all levels of manufacturing?

B.2 Export Controls[24]

In principle, the U.S. export control system should have very little, if any, competitive effect on U.S. high-tech firms relative to high-technology firms headquartered in other countries that subscribe to the multilateral control system.[25] There are, of course, valid national

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[24]Portions of this section are based upon the report, "Analysis of the Effects of U.S. National Security Controls on U.S.-Headquartered Industrial Firms," prepared by Quick, Finan & Associates for the Panel on the Impact of National Security Controls on International Technology Transfer of the Committee on Science, Engineering and Public Policy of the National Academies of Sciences and Engineering, August 25, 1986. The report analyzes the operation of the export license system and its competitive effects.

[25]The Coordinating Committee (COCOM) was established to facilitate the mutual security of the member countries through a uniform system of export controls. The 15-member countries are Belgium, Canada, Denmark, France, West Germany, Greece, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Turkey, the United Kingdom and the United States.

security reasons for establishing a system of export controls, but U.S. controls and procedures sufficiently differ from other COCOM countries in ways that place U.S. high-technology industries at a competitive disadvantage relative to other COCOM-headquartered firms in international sales.

The industrial sectors most likely to need a validated export license for some portion of their sales--and thus have to interact with the export control system--are the high-technology sectors. Whereas all U.S. traded goods face the same general macroeconomic set of conditions, the negative competitive effect of U.S. export controls falls fairly narrowly on these sectors. It is estimated that over half of U.S. high-tech exports in 1985 required some type of validated license. If the total foreign sales of U.S. firms are used as a base for measurement, in 1985 a total of nearly $80 billion of U.S. foreign sales required a validated license, or about one-fifth of the total. By either measure, the scope of activity covered by the U.S. license process is quite large.[26]

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[26]The total value of transactions covered by the export control system would also include the value of downstream distributor sales and sales of foreign firms (resale and reexport) using U.S. parts and components and/or technology. This significantly extends the scope of

Some of the sources of the competitive burden imposed by the license system on U.S. high-technology firms include: the way the licensing process functions and its complexity--uncertainty and delay are created for the exporter; the negative influence the controls have on the relationship between U.S. firms and their foreign customers since the U.S. system has a number of unilaterally-imposed procedures and constraints; and the disadvantages the system accords smaller exporters because the complexity of the system can require a staff of experts capable of managing the licensing process. Combined, these factors manifest themselves in competitive disadvantages for U.S. firms, for example, by directly inhibiting some firms from exporting (beyond legitimate restrictions imposed for national security purposes) or discouraging foreign customers from relying on a U.S. vendor or contributing to an erosion of foreign sales distribution networks.

It is difficult to measure empirically the extent of the effect of export controls on U.S. high-tech competitiveness overall. But for one U.S. high-technology sector, analytic instruments, a clear linkage has been

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economic activity potentially influenced by the U.S. control process.

documented between changes in U.S. export control regulations and the level of U.S. exports to COCOM destinations. In this particular case, because the changes in the controls were narrowly constructed and focused on a specific category of instruments' exports, we were able to isolate and measure the effects of discrete changes in the export control regulations on trade.

The measurement method accounted for exchange rates, the level of foreign economic activity (industrial production), changes in relative price levels to explain movements in analytic instruments trade, and included terms to capture the effects of changes in the degree of restrictiveness of U.S. export control regulations.[27] The results indicate that when the controls were first relaxed in mid-1984, analytic instruments exports were 7 percent higher in subsequent periods than they otherwise would have been. In late 1984, when new Department of Commerce regulations were implemented, more restrictive policies were put in place. By late 1985, these revised licensing rules reduced analytic instruments trade up to an estimated 12 percent below what it otherwise might have been. For

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[27]See Appendix B for the specification of the regression analysis.

perspective on the amount of these changes, they are about the same order of magnitude as the estimated effects of changes in exchange rates on analytic instruments exports in the same 1984-85 period.

The ability of U.S. high-tech firms to compensate in the market place for the negative competitive effects of export controls through better prices, or superior technology, or superior marketing and after-sale service/ support appears to be decreasing. Thus, foreign customers are reportedly more prone to give greater weight to export controls in making their sourcing decisions. Because a significant portion of U.S. exports shipped under validated licenses are low-sensitivity items (i.e., containing low-level technology), they are widely available abroad. Therefore, foreign customers are more likely to be driven to a foreign source by the presence of U.S. export controls.

In sum, export controls are probably having an increasingly negative effect over time as relative improvements in foreign technology availability continue and as foreign customers' sensitivity to U.S. export controls increases. The magnitude of the effect of changes

in U.S. export controls on analytic instruments trade suggests that, overall, U.S. high-tech exports could be severely penalized by the U.S. system of export licensing.

B.3 Foreign Trade Practices

While free trade policies are, in principle, the most efficient means of conducting international trade, in practice, many countries employ restrictive trade policies that aim to benefit certain of their industries. Because the U.S. has traditionally held a position of comparative advantage in high-technology industries, and specifically in electronics, the trade-distorting practices of U.S. trading partners are of particular concern to these industries since they block U.S. firms from achieving their full export potential.

In May 1985, the House Committee on Energy and Commerce surveyed U.S. companies for information on trade barriers.[28] A large majority (70 percent) of the complaints about unfair foreign trade practices received

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[28]Unfair Foreign Trade Practices: Barriers to U.S. Exports, Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, U.S. House of Representatives, May 1986.

through the survey involved nontariff barriers. Concern about nontariff barriers arises because they may be more restrictive than tariff barriers.[29] Moreover, as tariff levels are lowered due to Tokyo Round cuts, the trend toward the use of nontariff barriers is increasing.[30] Beyond traditional nontariff trade issues are new ones related to technology. Insufficient intellectual property protection in foreign countries and requirements that force U.S. companies to share technology in order to gain market access threaten the U.S. high-technology comparative advantage. Since it is the technology that is the basis of U.S. comparative advantage, these practices could have significant long-run impact on the U.S. competitive position.

The five most significant foreign nontariff barriers to U.S. high-tech exports are: government procurement codes, restrictions related to debt burden of developing countries, telecommunications authorities restrictions, insufficient intellectual property protection, and

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[29]A Policy Focus paper published by the Overseas Development Council, Non-Tariff Barriers: Growing Obstacles to U.S.-Third World Trade, 1986, states that nontariff barriers may be as much as 10 times as restrictive as tariffs.

[30]ibid., p. 2.

performance requirements. The types of barriers most often cited differed across sectors and among developed and developing countries. Offsets, subsidies, and licenses were the leading barriers reported by the aerospace industry respondents. Whereas for electronics sectors, the problems reported were related to standards, licenses, and customs.[31] The following table summarizes the type of foreign trade practices that negatively affect U.S. electronics' exports. Clearly, barriers related to electronics trade are widespread throughout both the developed and developing world. After high duties, preferential government procurement is the most commonly-used practice--cited for 40 percent of the countries covered in the survey.

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[31]U.S. House of Representatives report, Table 12, p. 23.

Table 3

Foreign Trade Practices Affecting Electronics Imports

Country	High Duties	Standards Testing/ Certification Requirements	Preferential Government Procurement	Offsets/ Countertrade	Intellectual Property Protection	Import Licensing/ Regulatory Requirements
EC	X	X	X			
Italy		X	X			
Netherlands		X				
Denmark		X		X		
UK				X		
West Germany		X	X	X		
Spain	X			X	X	
France		X	X			
Belgium		X		X		
Singapore					X	
Sweden		X		X		
Hong Kong					X	
Argentina	X		X		X	X
Japan		X	X		X	
New Zealand	X					
Brazil	X		X	X	X	X
South Korea	X				X	X
Mexico	X		X		X	X
Austria	X					X
Indonesia	X		X			
South Africa	X					
Thailand	X					
Taiwan	X				X	X
Malaysia	X			X		
China	X		X	X		
India	X		X			
Philippines			X		X	
Pakistan	X					X

Source: American Electronics Association.

B.4 Offsets

Offsets are defined to be a "range of industrial and commercial compensation practices required as a condition of purchase of military-related exports."[32] High-tech firms are the ones concerned about the practice of offsets, because they are considered to be a growing factor facilitating the diffusion to foreign firms of critical U.S. technical know-how. Thus, the concern is that this practice may be contributing to a long-term erosion of the U.S. technological lead in critical areas.

Criticisms of the use of offsets also revolves around U.S. prime defense contractors gaining a foreign sale at the expense of second- and third-tier U.S. subcontractors. This may occur because offset agreements often involve the transfer of know-how related to manufacturing components or subassemblies, or involve a requirement to establish local production of some of these items--both practices work to the competitive disadvantage of lower-tier subcontractors. The industries where offset practices are most commonly

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[32]This discussion of offsets is largely based on the interagency report Impact of Offsets in Defense-Related Exports (December 1985) required by Section 309 of the Defense Production Act Amendments of 1984. Definition of offsets from page 5 of the report.

found are high-technology sectors such as aircraft, aircraft engines and electronics. While most evidence related to offsets concerns the defense industries, some nondefense industries may also be affected. While--by definition--offset agreements are negotiated for the sale of military exports, nondefense sectors can be affected, because the offsets set up to generate the sale may not be directly related to defense sectors.

There are a wide variety of specific practices which fall under the general heading of offset. Coproduction, for example, is overseas production based on government-to-government agreements that permit the foreign government or producer to acquire the technical knowledge necessary to manufacture all or part of a U.S.-origin defense product. Various types of countertrade are also considered as forms of offsets: barter, the one-time exchange of goods or services; counterpurchase, an arrangement where the exporter agrees to find a buyer for some value of the importer's goods; and buy back, an agreement such that the exporter accepts products derived from the original export as payment.

The following examples of offset use demonstrate the potential ways offsets influence U.S. trade interests.

- In 1980, the Canadian government purchased the McDonnell Douglas/U.S. Navy F-18 fighter aircraft with an offset agreement valued at 120 percent of the aircraft price. The indirect offsets included in the agreement extended from jet engines to fiber optics, auto parts, health care products, and even tourism. A Canadian facility is now exporting fighter components to the U.S. as a consequence of this offset purchase agreement.

- A Netherlands firm, not previously involved in the aerospace industry, now competes for landing gear contracts on a worldwide basis as a result of receiving a 1976 offset contract from General Dynamics for the F-16 landing gear.

- An offset agreement between a U.S. and an Italian firm transferred technology for three U.S. Sparrow missiles at a cost of $40 million. Italy is now exporting the Aspide missile, considered superior to the latest U.S.

Sparrow missile, which costs 10 times as much to develop.

One estimate has placed the average annual value of defense-related offsets of the type illustrated above at between $2 to $3 billion for the period 1980 to 1984.[33] This would suggest the practice is significant enough in scope to influence U.S. high-tech trade in some sectors. The available evidence also suggests the practice of offsets is probably increasing, especially in the parts of the world where concerns about debt have limited a country's ability to pay hard currency or take on additional debt to fund military purchases. Offsets may also be gaining as a practice due to a deterioration in the competitiveness of U.S. firms and an increase in their customers' ability to demand compensation arrangements as part of an overall sale.

As the use of offsets has increased, there has been a rising concern regarding their long-term consequences. A major competitive concern is that offsets are possibly contributing to increased foreign competition by aiding the development of foreign technology and production bases. In

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[33] Impact of Offsets in Defense-related Exports, p. 18.

industries where technical superiority is a principal competitive advantage, this can mean a long-term loss of competitive position. This can be weighed against the fact that, on the other hand, offsets may allow U.S. companies to make foreign sales they would not otherwise be able to make, because foreign governments increasingly require some form of offset agreement when negotiating for purchase of U.S. defense equipment.

Conclusion

Over the past six years, U.S. macroeconomic policies, combined with other factors, have led to a marked deterioration of the U.S. international competitive position in high-technology trade. In 1986, it is expected, for the first time since data has been available on the high-technology sector, that the United States may run a trade deficit in high-tech trade, projected to exceed $2 billion.

The strength of the dollar and faster U.S. growth relative to our major trading partners were certainly contributors to the steady decline in the U.S. high-tech trade balance observed between 1980 and 1986. A U.S. advantage in high-tech sectors due to its technology lead was supposed to insulate this sector from competitive price pressures. Obviously, if this was ever the case, it is not the case any longer. The trend which demonstrates this point most clearly is the U.S. performance relative to Japan, especially in electronics trade. The U.S.-Japanese trade balance shows a consistent, extensive decline, despite fluctuations in exchange rates and relative rates of growth of the two nations' economies. While not part of

this assessment, an important topic for further study is the careful examination of the quality of the U.S. technological base, with an appraisal of the degree to which any decline is related to an erosion of our qualitative advantages in research and development. This should be a matter of major concern since the research-intensive industries also serve as a major support for U.S. strategic objectives.

In addition to the adverse macroeconomic conditions, U.S. high-tech competitiveness is being encumbered by U.S. export controls and by numerous foreign trade-distorting practices, including offsets. These factors are not faced to the same degree by the major foreign-based competitors of American firms. It is difficult to precisely estimate how much each of these other factors contributed to the overall decline, but in specific instances, these factors have played a significant role in contributing to a decline in the U.S. competitive position.

One way U.S.-based high-tech firms have responded to the deteriorating competitiveness of the U.S. as a place for production and engineering has been to relocate facilities to, and to outsource from, low-labor-cost

countries. This movement offshore--while not as pronounced in the aggregate as in particular industries and for particular countries--raises an issue regarding U.S. policy interests: We must draw a distinction between the comparative advantage of the U.S. as a geographic place of production and the competitiveness of U.S.-based firms in a global context.[34]

Implications of such a distinction are several. If U.S. firms are able to maintain their competitive position by shifting facilities and sourcing offshore, then it is the U.S. as a geographic location of production and the factors specific to it that have lost relative competitiveness. But if U.S. firms have lost their competitiveness as evidenced by a decline in their global market share, then it is U.S. firm-specific attributes that are in decline.[35]

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[34]This proposition was first advanced by Robert Lipsey and Irving Kravis in "The Competitive Position of U.S. Manufacturing Firms," National Bureau of Economic Research Working Paper #1557.

[35]For a direct test of this proposition, see Irving S. Kravis and Robert Lipsey, "The Competitiveness and Comparative Advantage of U.S. Multinationals, 1957-83," unprocessed, July 15, 1986. They suggest that, overall, it is the U.S. as a place of production that has declined in competitiveness due to adverse movements in the U.S. price level.

The evidence collected from the U.S. trade data suggests that in some high-technology sectors, the U.S. technical and engineering work force may have lost its competitiveness and that the once-dominant qualitative advantages of the U.S. R&D base may have been significantly narrowed. As a result, a complex international division of activity is emerging in some high-tech sectors, as U.S. firms seek to maintain their competitive position vis-a-vis their foreign-based competitors. Whether such steps that maintain U.S. high-tech firms' competitiveness benefit the overall U.S. economy in the long run is an important question.

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Figure 16: Real Trade Weighted Exchange Rates

Note: Data sources for these charts appear in Appendix A.

Figure 1

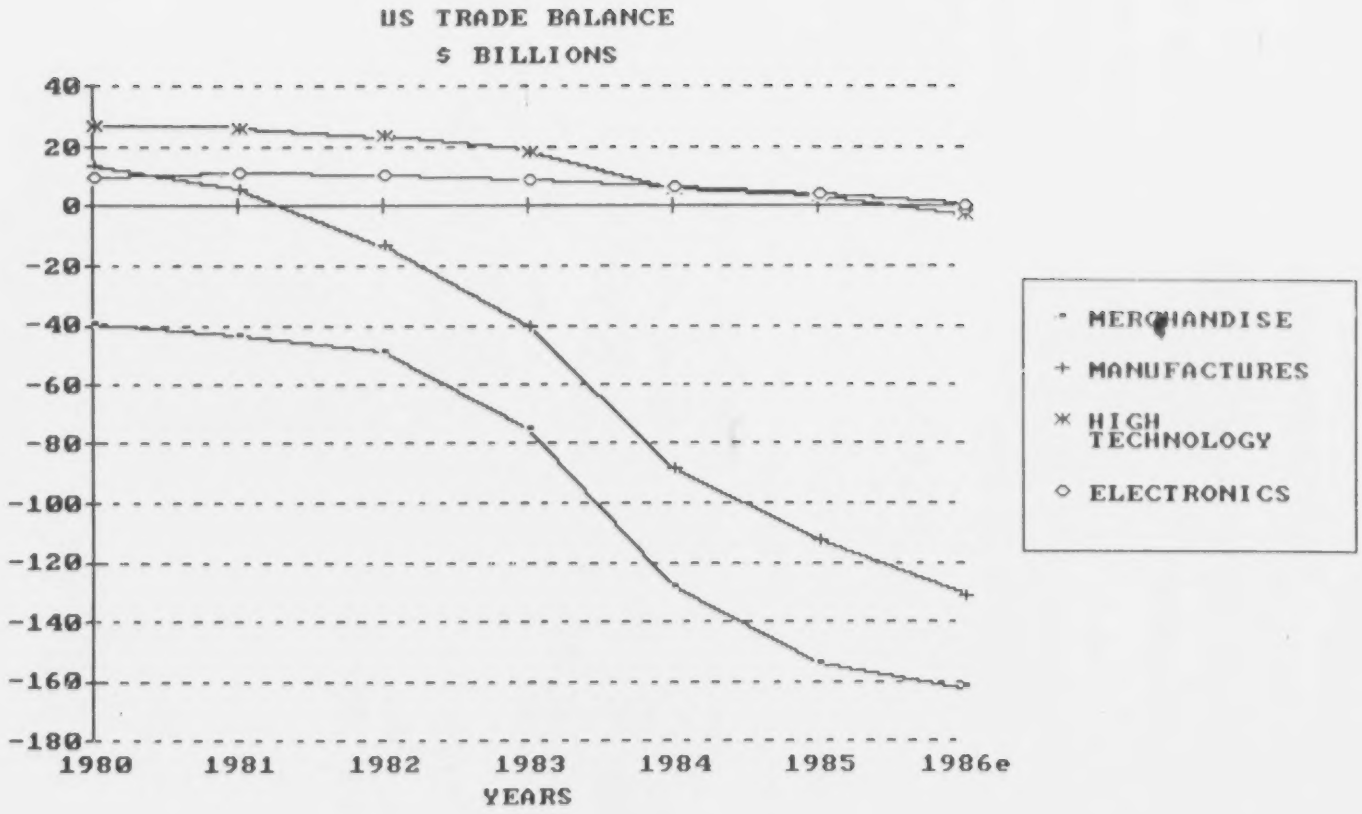
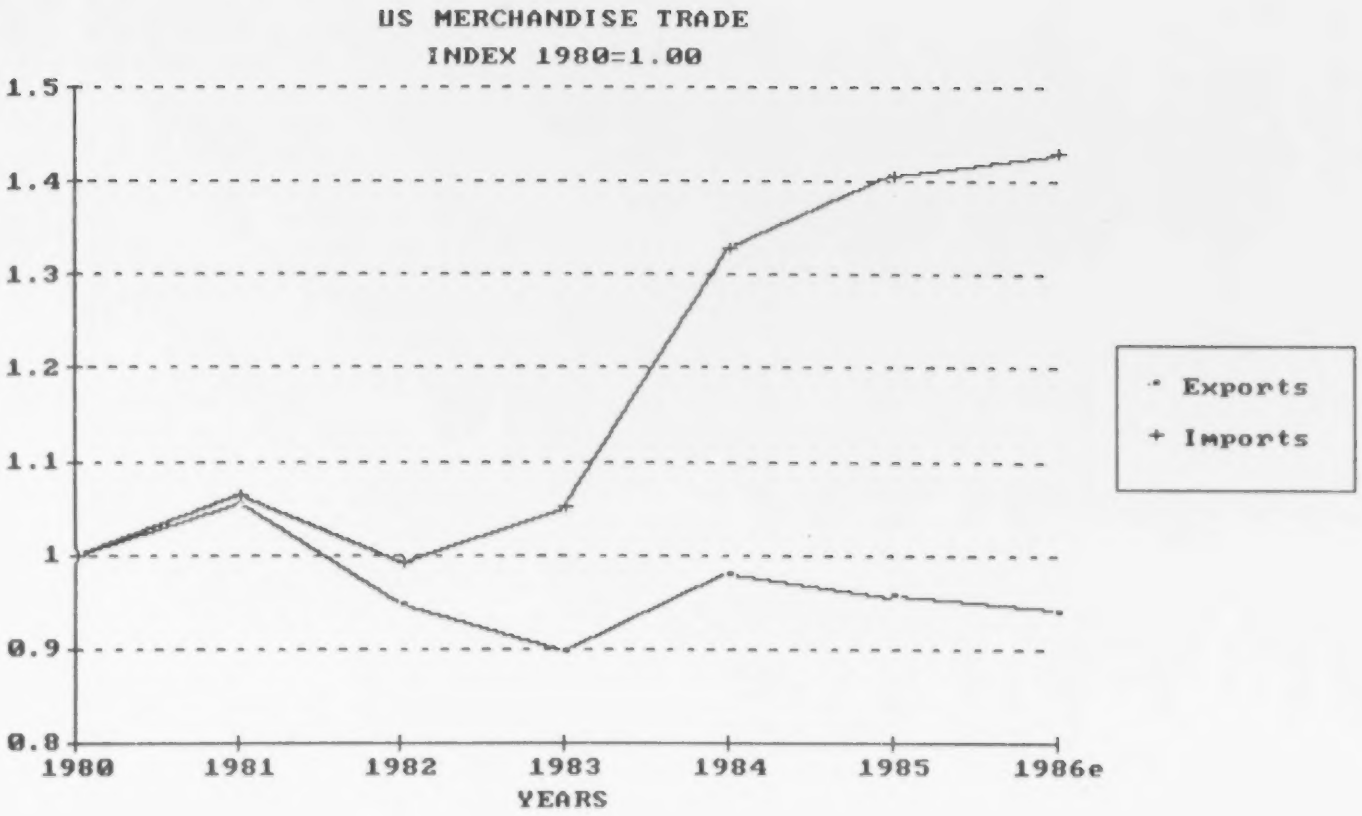

US TRADE BALANCE
$ BILLIONS
40
20
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
1980
1981
1982
1983
1984
1985
1986e
YEARS
MERCHANDISE
MANUFACTURES
HIGH TECHNOLOGY
ELECTRONICS

Figure 2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1.3
1.2
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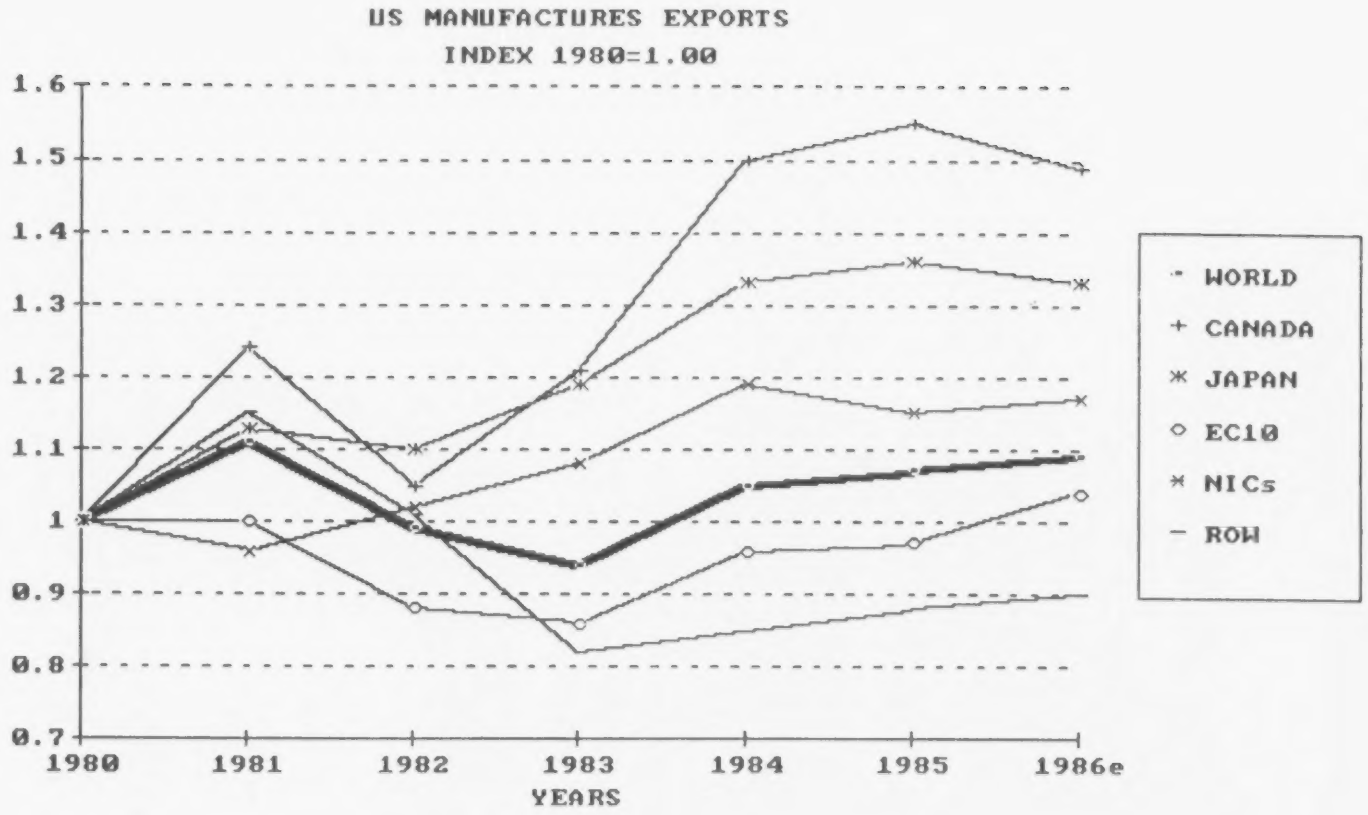
0.9
0.8
1980
1981
1982
1983
1984
1985
1986e
YEARS
Exports
Imports

Figure 3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1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
1980
1981
1982
1983
1984
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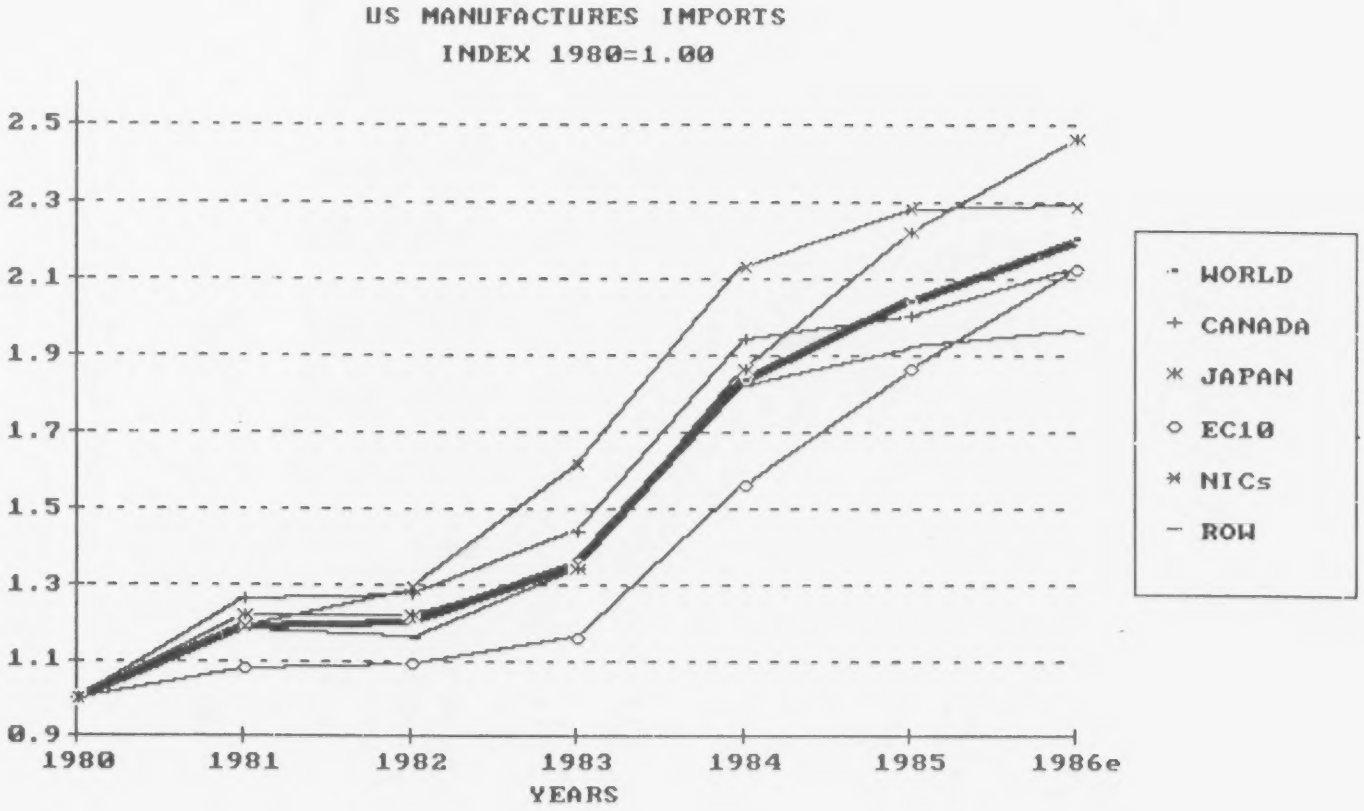
1986e
YEARS
WORLD
CANADA
JAPAN
EC10
NICs
ROW

Figure 4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2.1
1.9
1.7
1.5
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1.1
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1980
1981
1982
1983
1984
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CANADA
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NICs
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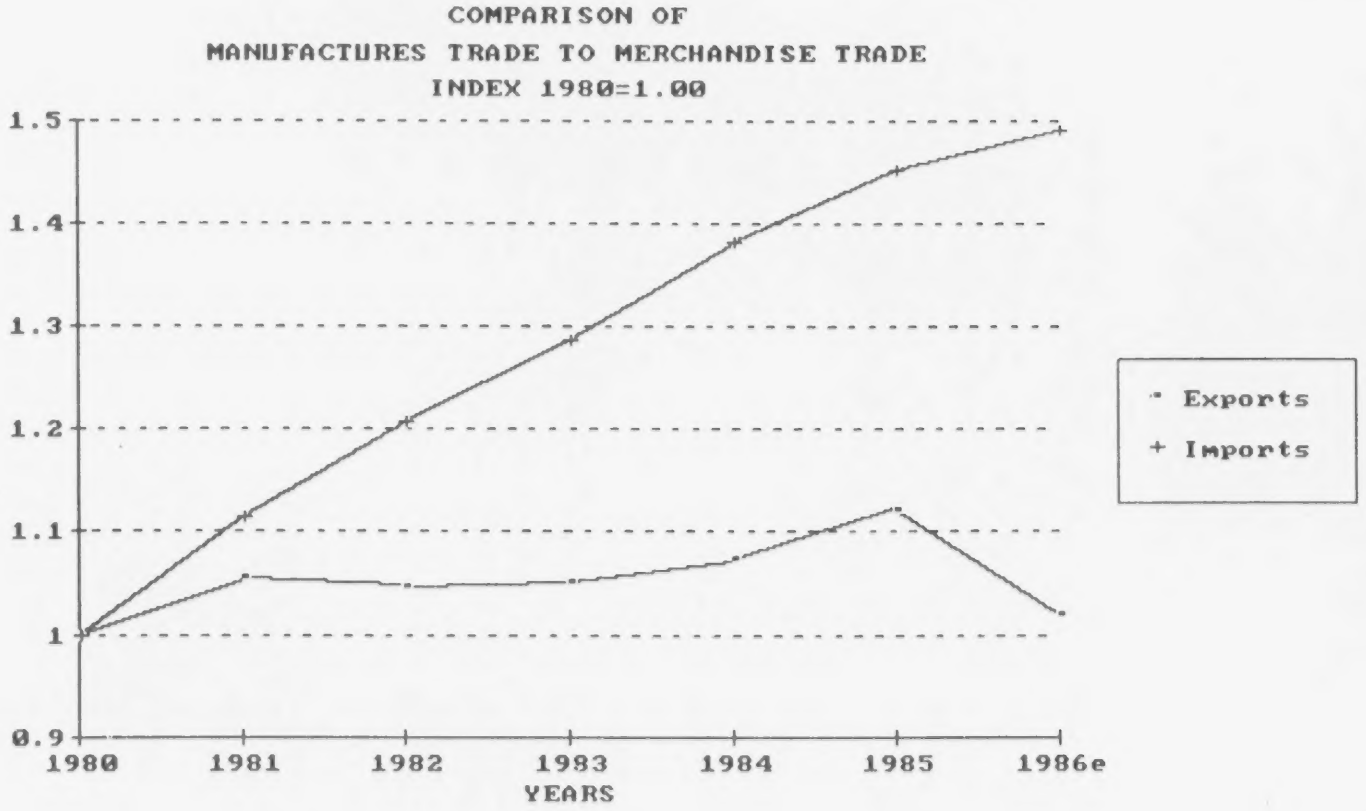
Figure 5


COMPARISON OF
MANUFACTURES TRADE TO MERCHANDISE TRADE
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1.4
1.3
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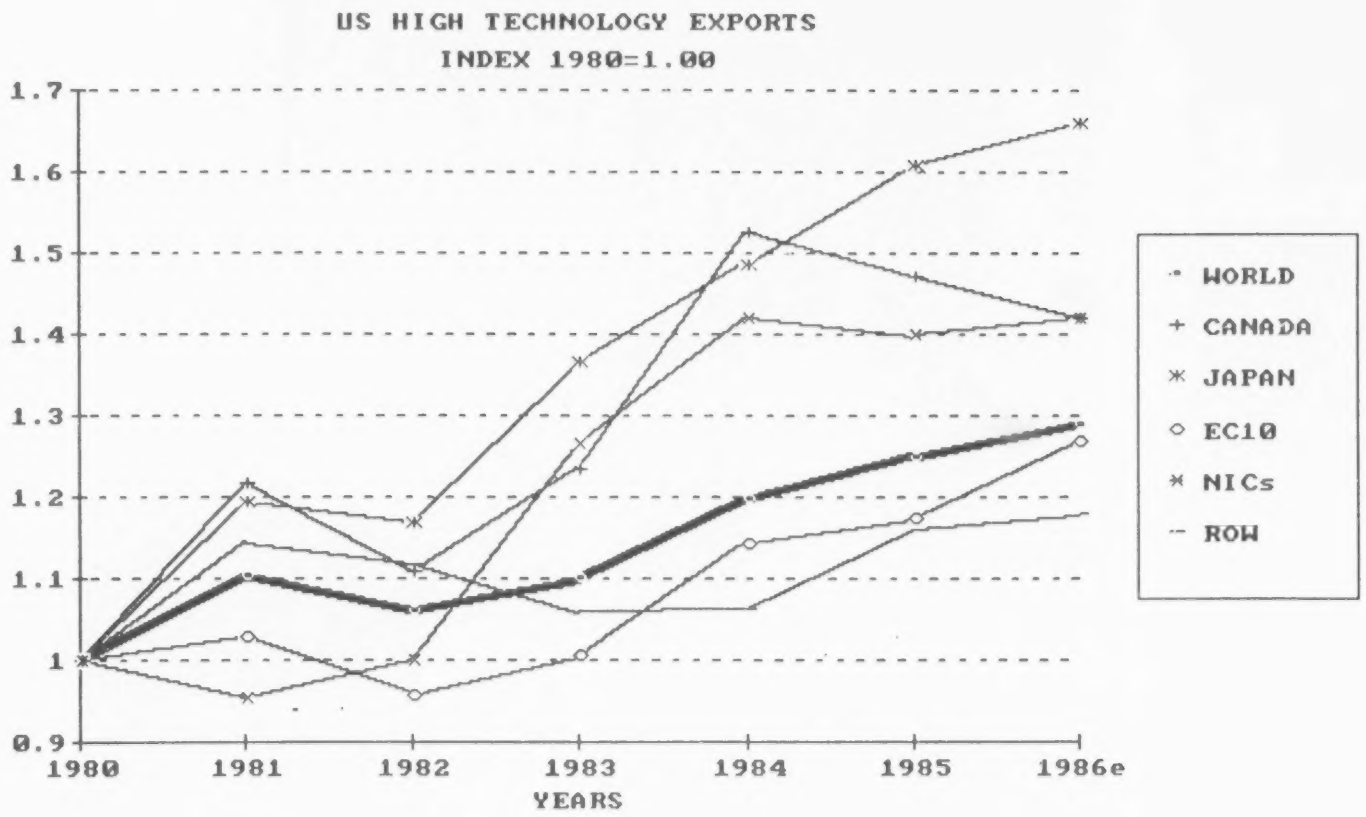
1.1
1
0.9
1980
1981
1982
1983
1984
1985
1986e
YEARS
Exports
Imports

Figure 6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1.5
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1.3
1.2
1.1
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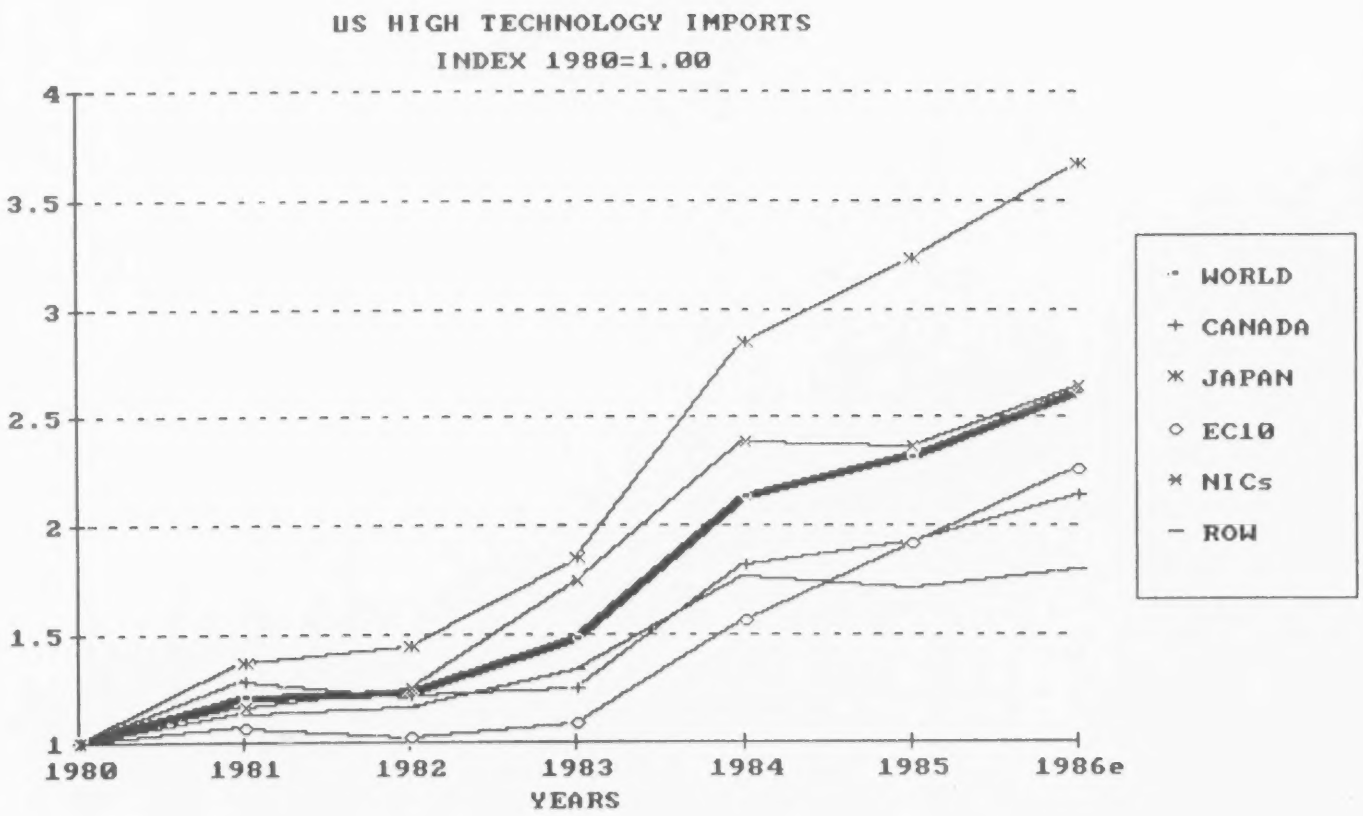
0.9
1980
1981
1982
1983
1984
1985
1986e
YEARS
WORLD
CANADA
JAPAN
EC10
NICs
ROW

Figure 7


US HIGH TECHNOLOGY IMPORTS
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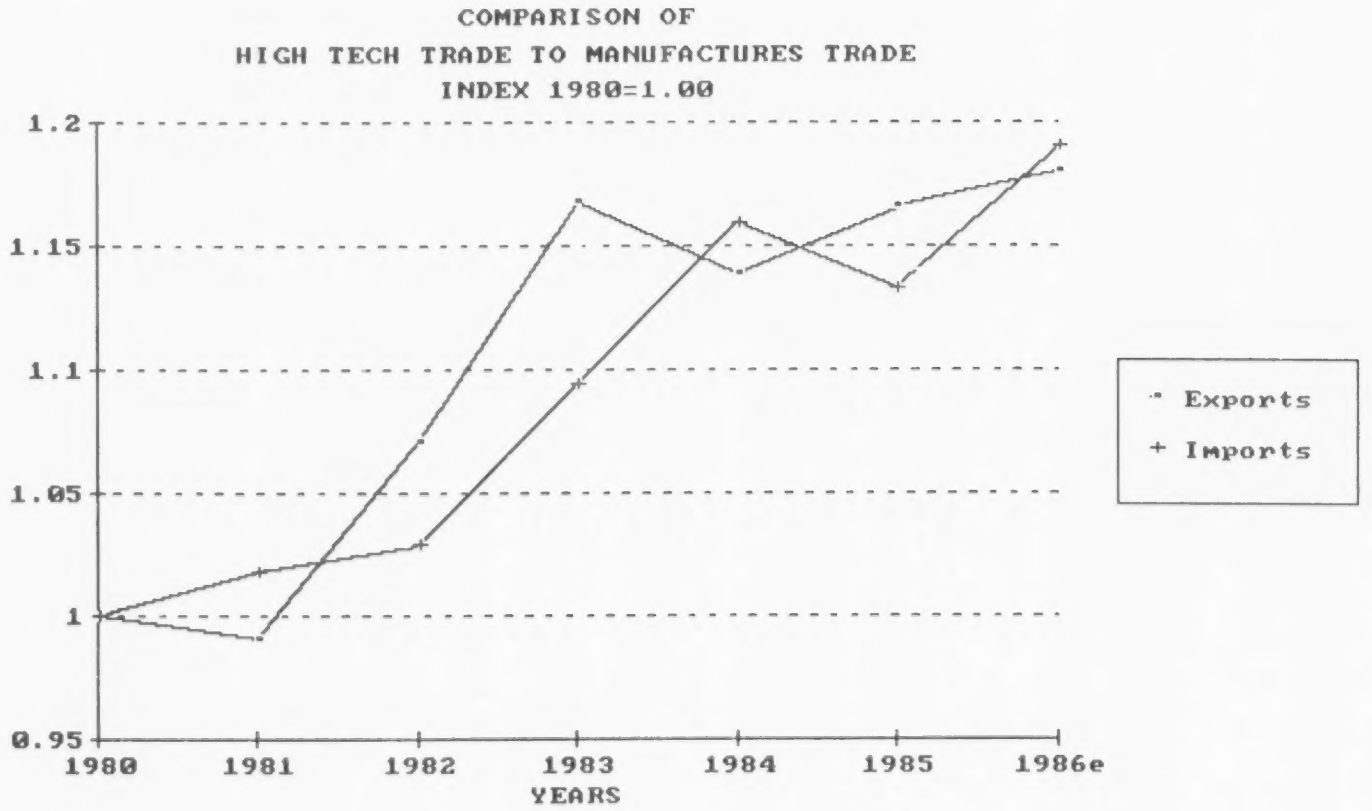
1982
1983
1984
1985
1986e
YEARS
WORLD
CANADA
JAPAN
EC10
NICs
ROW

Figure 8


COMPARISON OF
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1.2
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1.1
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1
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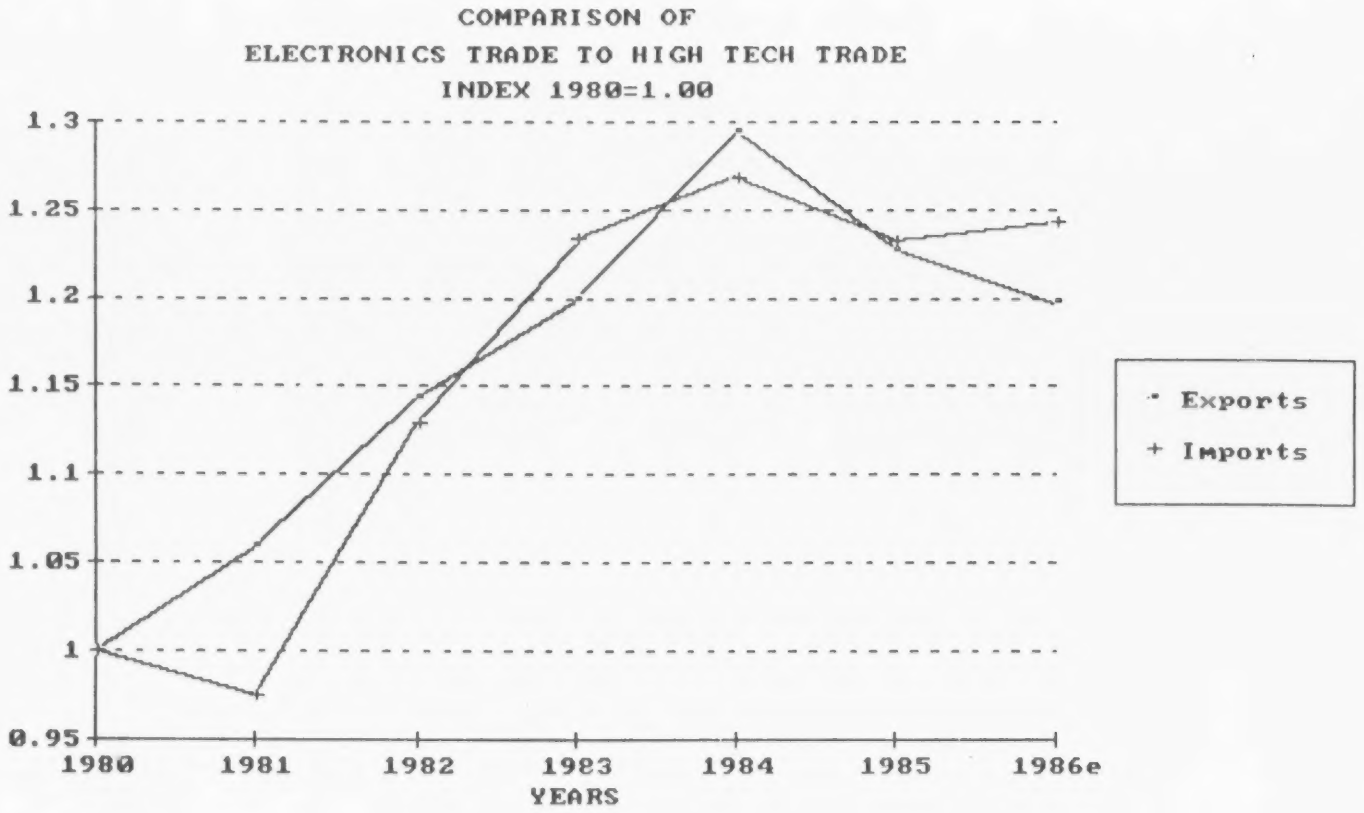
1980
1981
1982
1983
1984
1985
1986e
YEARS
Exports
Imports

Figure 9


COMPARISON OF
ELECTRONICS TRADE TO HIGH TECH TRADE
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1.25
1.2
1.15
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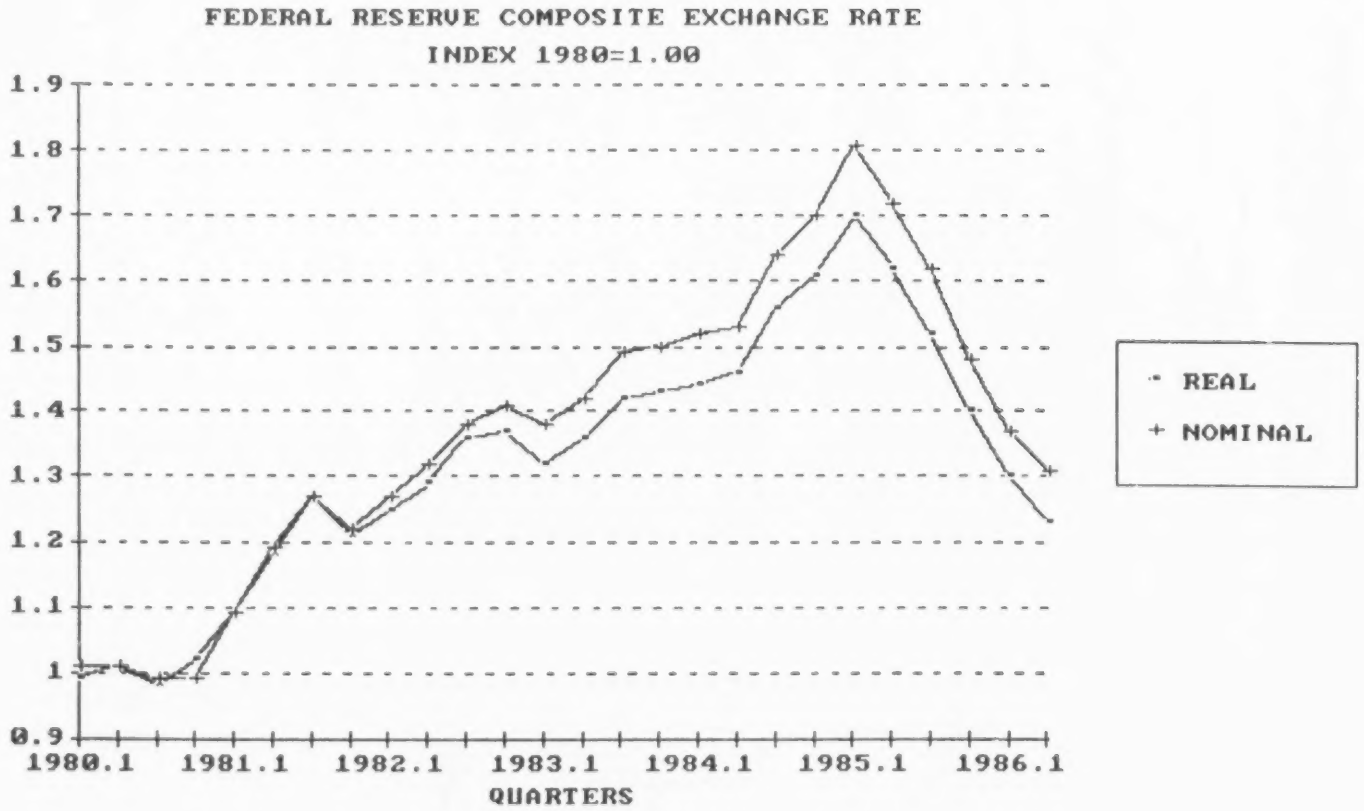
0.95
1980
1981
1982
1983
1984
1985
1986e
YEARS
Exports
Imports

Figure 10


FEDERAL RESERVE COMPOSITE EXCHANGE RATE
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1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
1980.1
1981.1
1982.1
1983.1
1984.1
1985.1
1986.1
QUARTERS
REAL
NOMINAL

Figure 11

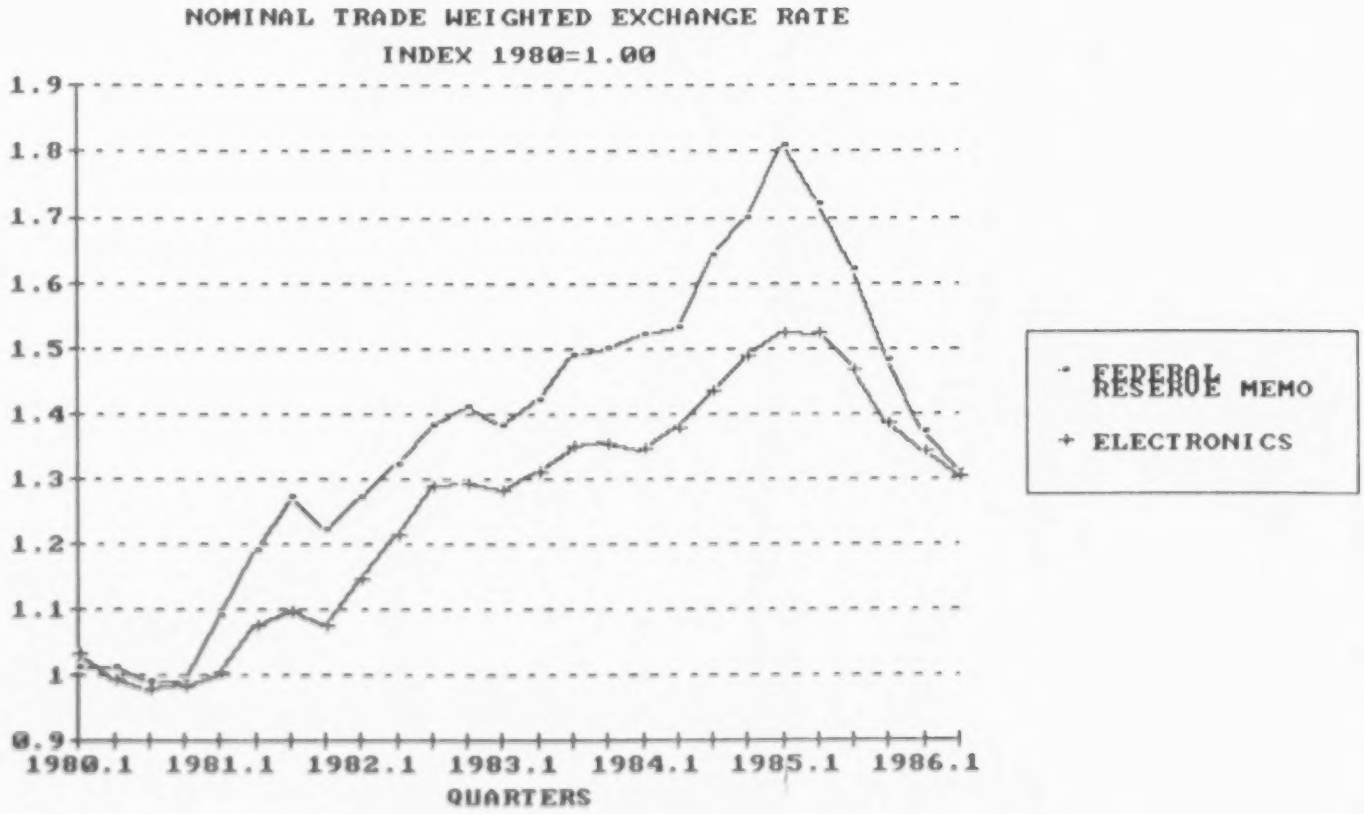

NOMINAL TRADE WEIGHTED EXCHANGE RATE
INDEX 1980=1.00
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
1980.1
1981.1
1982.1
1983.1
1984.1
1985.1
1986.1
QUARTERS
FEDERAL RESERVE MEMO
ELECTRONICS

Figure 12

REAL TRADE WEIGHTED EXCHANGE RATE
INDEX 1980=1.00
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
1980.1
1981.1
1982.1
1983.1
1984.1
1985.1
1986.1
QUARTERS
ELECTRONICS

Figure 13

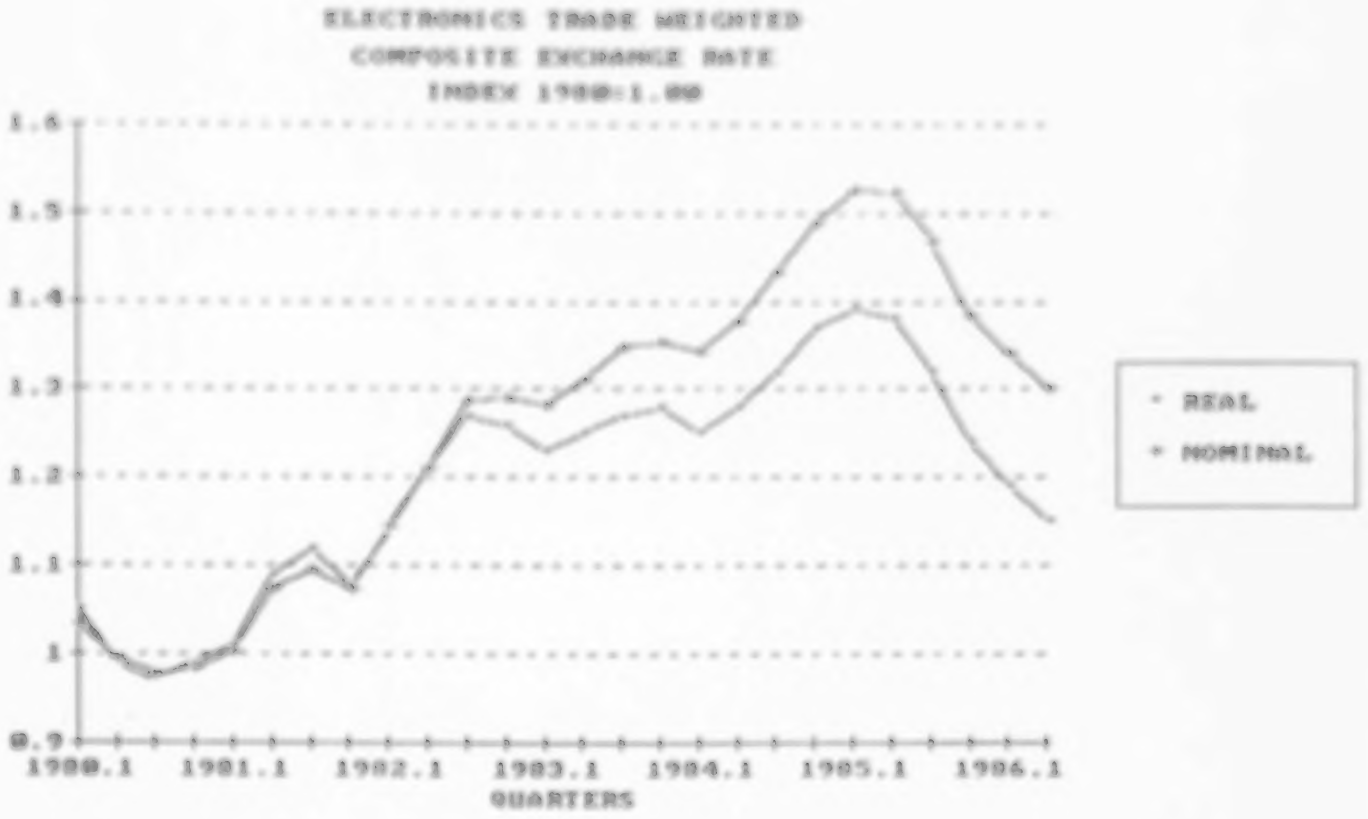

ELECTRONICS TRADE WEIGHTED
COMPOSITE EXCHANGE RATE
INDEX 1980:1.00
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
1980.1
1981.1
1982.1
1983.1
1984.1
1985.1
1986.1
QUARTERS
REAL
NOMINAL

Figure 14

REAL EXCHANGE RATES
INDEX 1980=1.00

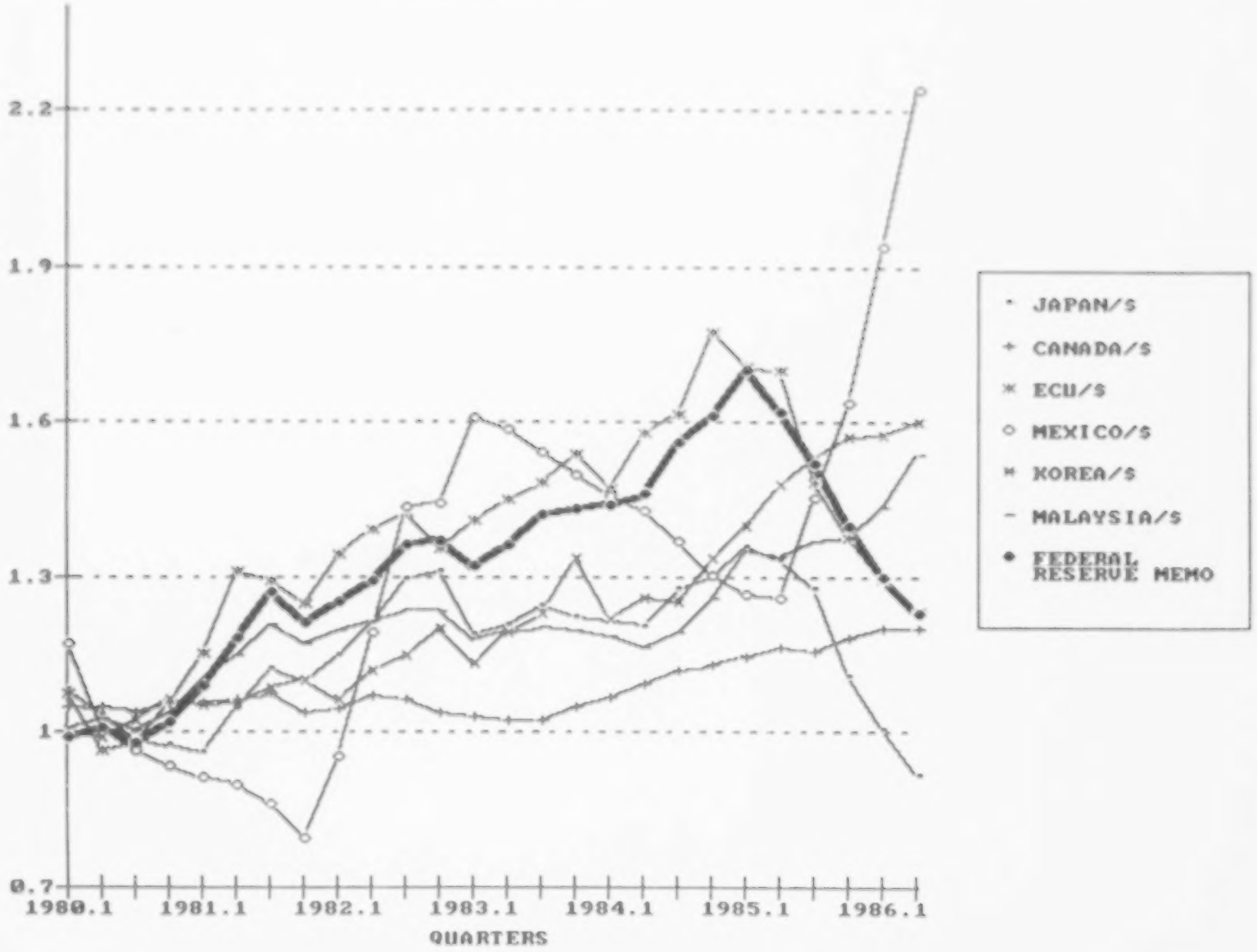


Figure 15

NOMINAL EXCHANGE RATES
INDEX 1980=1.00

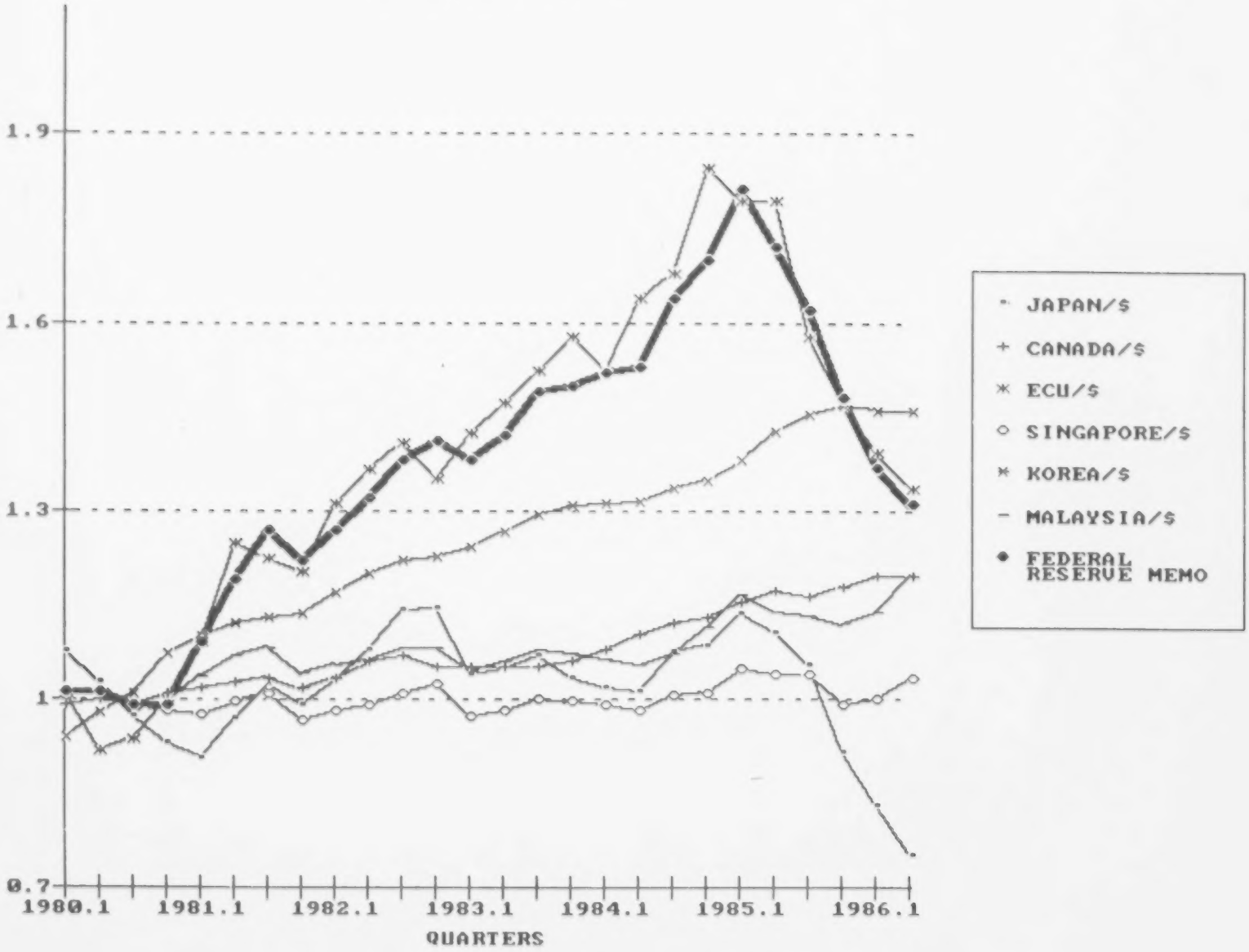
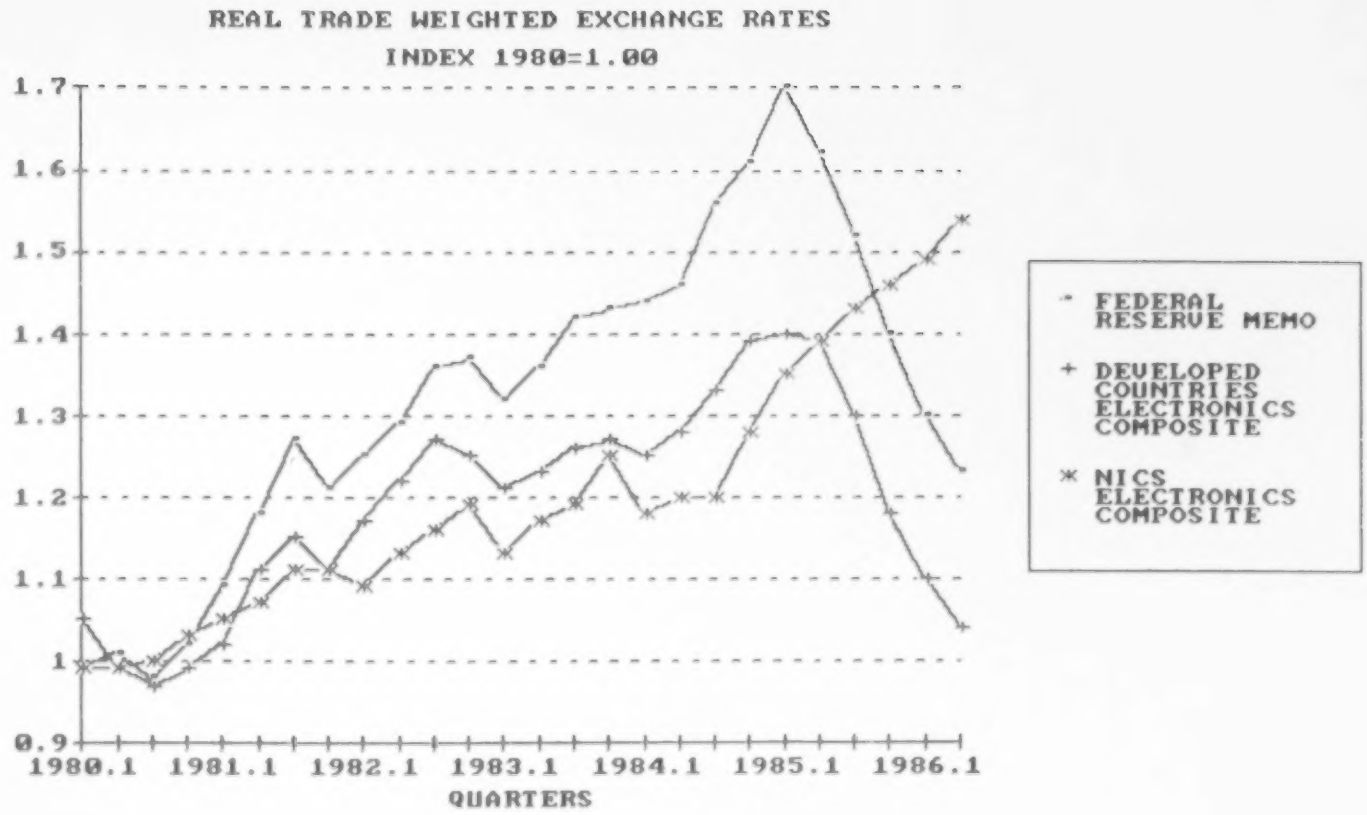


Figure 16


REAL TRADE WEIGHTED EXCHANGE RATES
INDEX 1980=1.00
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
1980.1
1981.1
1982.1
1983.1
1984.1
1985.1
1986.1
QUARTERS
FEDERAL RESERVE MEMO
DEVELOPED COUNTRIES ELECTRONICS COMPOSITE
NICS ELECTRONICS COMPOSITE

Appendix A

Definitions and Primary Sources of Data

I. Trade Data

1. 1986 full-year estimates are based on actual 1986 first-half data.

2. Merchandise and Manufactures Trade

   Sources: U.S. Department of Commerce, 1985 U.S. Foreign Trade Highlights; U.S. Department of Commerce.

3. High-Technology Trade in this report is defined by U.S. Department of Commerce definition DOC3, which is based on R&D expenditures as a percentage of shipments. SIC categories included in this definition are: industrial inorganic chemicals (281); plastic materials and synthetic resins, synthetic rubber, synthetic and other man-made fibers, except glass (282); drugs (283); ordnance and accessories, except vehicles and guided missiles (348); engines and turbines (351); office, computing and accounting machines (357); radio and television receiving equipment, except communication types (365); communication equipment (366); electronic components and accessories (367); aircraft and parts (372); guided missiles and space vehicles and parts (376); measuring, analyzing, and controlling instruments, photographic, medical and optical goods, watches and clocks (38)--except instruments for measuring and testing of electricity and electrical signals (3825).

   Sources: U.S. Department of Commerce, United States Trade Performance in 1984 and Outlook; 1985-86 trade data supplied by Department of Commerce.

4. Electronics trade is defined as a subset of high-technology trade and includes: SIC 3573, 367, 3661, 3662, 3574, 3579, 38612, 386147, 3693, 3811,3822, 3823, 3824, 3825, 3829, 3832.

   Source: U.S. Department of Commerce.

II. Trade Weighted Exchange Rates

The nominal quarterly exchange rates from 1980 to 1986 were logged, weighted by 1985 total U.S. electronics trade and indexed. Real exchange rates were calculated by adjusting the nominal rates by the GDP price deflator. The real exchange rates were then relogged, weighted and indexed. The Federal Reserve MEMO is an index of the geometric weighted-average foreign exchange value of the U.S. dollar against currencies of the other Group-of-Ten countries plus Switzerland.

Sources: International Monetary Fund International Financial Statistics, selected issues; Federal Reserve Bulletin, selected issues; American Electronics Association 1985 electronics trade data, provided by the U.S. Department of Commerce, mimeo.

III. Offshore Sourcing

Asset and square footage data was collected from a sample of 40 Fortune 500 companies' 1980 and 1985 annual reports and Form 10K statements submitted to the Securities and Exchange Commission. U.S. foreign direct investment data was obtained from the U.S. Department of Commerce.

Appendix B

Export Controls Case Study: Analytic Instruments

For analytic instruments trade, a clear linkage can be documented between changes in the export control regulations and the level of U.S. exports to COCOM destinations.[36] With respect to non-Communist Bloc destinations, discrete changes in the definition of "embedded" microprocessor resulted in an average 7 percent increase in exports within a few months after controls were relaxed. When the controls were tightened, there was an average 12 percent decrease in the value of U.S. exports of analytic instruments to COCOM destinations.

As far back as 1979, there were U.S. unilateral export controls on microprocessors embedded in analytic instruments. Through the early 1980s, the Defense Department was reluctant to loosen the controls. Finally, in April 1984, the Department of Commerce (DOC) announced decontrol of almost half the categories of analytic instruments. But eight months later, DOC issued new COCOM regulations that essentially recontrolled all the instrument categories through the definition of embedded microprocessor.

It is difficult to verify quantitatively the linkage between changes in the export control regulations and changes in aggregate export sales. But in this particular case, there was a unique opportunity to isolate and measure the effects because of the discrete, narrowly-constructed regulatory changes that focused on a specific category of exports. Trade data was obtained on U.S. exports of analytic instruments from the Department of Commerce for the period 1978 through 1985. The Commodity Control List (CCL) category of relevance is 4529B. This was cross-referenced to Commodity 711 (excluding 711.8001) of the U.S. Exports of Schedule E.

A relationship was specified to account for normal trade-determining effects and, in addition, accounted for the changes in export control regulations related to analytic instruments. In the analysis, exchange rates, level of foreign economic activity (industrial production),

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[36]Excluding Canada because no validated license is needed for exports to a Canadian destination.

and changes in the price level were accounted for, along with two terms to capture the effects of changes of the export control regulations. Looking only at U.S.-COCOM exports (less Canada), the following equation was specified:

$$RAI = a + b_1*IP + b_2*XR + b_3*D_1 + b_4*D_2$$

The variables of the regression are defined to be:

RAI = value of real U.S. exports of analytic instruments to COCOM (less Canada)

IP = weighted, aggregated industrial production indexes for COCOM countries (excluding U.S. and Canada)

XR = 4 quarter moving average of weighted exchange rates for COCOM countries (excluding U.S. and Canada)

D_1 = time dummy for 1984.2-1985.1 represents loosening of export controls

values: 84.2 = .25, 84.3 = 1.0, 84.4 = .5, 85.1 = .25

D_2 = time dummy for 1985.2-1985.3 represents tightening of export controls

values: 85.2 = .5, 85.3 = 1.0

The results of an OLS regression were:

	coefficient	(t-statistic)
a	= -20.80	(- 1.41)*
b_1	= 0.92	(-12.01)**
b_2	= - 0.27	(6.39)**
b_3	= 3.34	(1.33)*
b_4	= - 4.93	(- 1.82)**

*significant at the 0.10 level
**significant at the 0.05 level

$\bar{R}$ = 0.87

F = 42.20

Time period = 1978.2-1985.3

The regression results are quite interesting. The terms included to capture the effects of changes in the export licensing system enter with the correct sign and are statistically significant. The results indicate that when the controls were modified in 1984, analytic instruments exports were, by the third quarter, 7 percent higher than they otherwise would have been. The relaxation was reversed in late 1984 when new DOC regulations were implemented. These more restrictive export licensing rules reduced analytic instruments trade around 12 percent below what it otherwise might have been by the third quarter of 1985. These changes are the same order of magnitude as the effects of changes in exchange rates for the 1984-85 period. These changes in exports are only the short-run changes; also not captured in these results are any effects in foreign markets for analytic instrument sales made by U.S. affiliates.